NATURAL SCIENCE SERIES.

PART VI.

THE HUMAN BODY.

STATE NORMAL SCHOOL.
BRIDGEWATER, MASS.
1889.

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THE HUMAN BODY.

THE WHOLE BODY.

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Principal parts—Parts of the Head, Neck, Trunk, Arm, and Leg.

Uses of parts—Care of parts—Alcohol and Tobacco.

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THE HUMAN BODY.

THE WHOLE BODY.

Position. Teach each child to observe his own and others' positions while sitting, standing, and walking. He should desire and strive to be erect. Lead him to compare his positions with those of other animals.

Color. White and black people are known to most children. Teach yellow, red, and brown when Chinese, Indians, and Malays can be seen.

Size. Each pupil should know his own height. Get parents if possible to record at regular intervals the heights of their children and and dates of measurement. Shoes should be removed before the measure is taken. If the height and date are marked also on a wall or a board made for the purpose the children can compare the growth during different intervals. Lead each child to compare the distance he can stretch with his height, to compare the size of his arms, of his hands and to try to make the smaller larger and stronger.

Weight. Each pupil should know his own weight. Parents should record weight and height at the same time, and mark the weight beside the height that the children can compare changes in height and weight during equal intervals. The practice should be continued throughout the period of growth.

THE EXTERNAL PARTS OF THE BODY.

Pupils should touch and name the parts in regular and irregular order. A class gymnastic exercise can be derived easily from the touching.

Principal parts. Head, neck, trunk, upper limbs or arms, lower limbs or legs ; right and left.

Parts of the head. Crown, back, sides, hair, ears, face ; parts of the face,—forehead, temples, cheek, chin, eyes, brows, lids, lashes, nose, nostrils, bridge of the nose, mouth, lips.

4. Close your eyes. Try to read with your fingers these raised letters used by the blind. Tell why the blind are able to do it so easily. What can we do to increase the delicacy of our touch?

Question. Of what use are the long hairs on a cat's nose?

The Sense of Sight.

Procure from a butcher three or four eyes. They may be from oxen, sheep, or swine. From two of them remove the muscle and fat taking care not to injure the optic nerve which is easily seen protruding from the flesh. Get if possible the skull of some small animal. To prepare a skull boil the head of an old animal until the flesh separates easily from the bones. Pick out the inner passages. Clean the bones and dry thoroughly.

Experiments.

1. Close your eyes. Tell the color of the card in my hand. Open your eyes. Tell the color of it.

Repeat these experiments in a dark room or closet.

State with what and when we see objects.

2. Feel very carefully of your eye. Observe the shape of this eye. Teacher presents the eyeball (muscle and fat removed) of an ox.

State the shape of the eye.

3. Observe how many and what colors your eye has. Observe carefully the shape of each colored part. Observe your neighbor's eyes.

State the shape and the name of each colored part.

4 Make a hole in a closed box. Observe the color of the hole. Look at a window at which the blinds are open and the curtains drawn aside. Then observe in a similar way the eye of an ox or pig. To show that the pupil is a small hole let the teacher cut into the side of an eyeball from which the muscle and fat have been removed. Introduce one point of the scissors and cut around the eye half way between the optic nerve and iris. Remove the front half of the coats allowing the vitreous humour and crystalline lens to drop upon the back half of the coats.

Observe the color of this pupil as I hold it in the dark doorway. Observe the pupil as I hold it to the light. Observe the pupil of your own eye and infer what it is.

5. Observe the size of the pupil and of the iris of your neighbor's eye when he is in a dark place, a light place, and in a very light place.

State the uses of the pupil and iris.

6. Feel of the part of your head in which your eye is. Observe in the small skull where the eye was. Observe what is on the eyeball.

State what parts you find and their uses.

7. Find four other parts near and upon the eyeball and their uses.

8. Observe carefully the eyes of cats, dogs, horses, cows, and birds to find in what they are alike and different.

Care of the eyes. Imbue your pupils with a deep and lasting respect for their eyes and emphasize the necessity of constant and proper care of them. The following rules are within the comprehension of younger pupils and should be carefully followed by them:

Never roll or squint your eyes.

Do not rub your eyes. If there is something the matter with your eyes ask older persons for help.

Never read lying down or stooping.

Never read by twilight or by an unsteady light.

Never let the sunlight shine directly on your book or the object you are studying. Let the light come from the left or left and rear.

Do not face a bright light.

Do not hold your work near the eyes.

Rest the eyes when using them steadily by looking up occasionally.

Teachers should test pupils' eyes for near-sightedness, far-sightedness, astigmatism, and color blindness. Pupils with weak or diseased eyes should be urged to consult a skillful oculist.

The Sense of Hearing. Experiments.

1. Close your eyes. Listen. Teacher drops an object.

State what happened and how you knew.

2. Close your eyes. Hold the fingers on the openings into the ears. Listen. Teacher makes the same slight noise as before. Repeat with different objects.

State what happened and how you knew it. Infer where is the part with which you hear and when you hear.

3. Observe the position and shape of the outer ear. Observe the action of deaf people.

State the use of the outer ear.

4. Observe the position and shape of the canal and the hairs and wax contained.

State the use of each part.

5. Observe closely the position, shape, motion, and use of the outer ears of a dog, a cat, a horse, a cow. Has a hen ears? Can fishes hear?

6. Observe how deaf people understand what is said.

Care of the ears. Teach pupils not to pull or put anything in their ears; to cleanse them properly. How can we increase our power to hear?

Teach them to listen attentively but not to be eavesdroppers.

The Sense of Taste. Experiments.

1. Close your eyes. Tell the taste of what I have in my hand. Open your eyes. Tell the taste of the substance. Close your eyes and open your mouth. Teacher puts the substance on the tongue of each. Tell the taste of it.

State with what we taste.

2. Stir a little sugar in some water. Stir a little sand in some water. Observe all the changes which take place.

State where the sugar is and what its present condition is called.

3. Wipe your tongue dry. Hold your mouth open and your tongue still until I tell you to stop. Close your eyes. As soon as you taste the substance put on your tongue raise your hand. Be sure to distinguish between touching and tasting. Teacher drops a little sugar on the front part of the tongue. When did you taste the substance? Why?

Repeat the experiment using sugar in solution.

Repeat both experiments with salt or alum. Use glass or a piece of quartz.

State when we taste and what.

4. Close your eyes and hold the mouth open and the tongue still. As soon as you taste the substance placed on your tongue raise your hand. Teacher drops something on the front part of each tongue and when the taste of the first has gone drops a little more on the back of each tongue. Take the experiment with sugar, salt, and substances having very little flavor.

State with what part of the tongue you can taste most delicately.

5. Open your mouth before a mirror. Observe the small pointed piece of flesh hanging down from the back part of your mouth. It is the soft palate. Taste carefully of a substance and observe what you do with the tongue and soft palate.

State a use of the soft palate.

Teach the flavors bitter, sweet, saline, acid.

Care of the mouth. Teach pupils to cleanse the mouth and teeth thoroughly after each meal to prevent decay of the teeth and a bad odor. Teach the effect of burning the tongue and of very hot or cold drinks on the sense of taste.

Alcohol and tobacco. Teach the immediate effect of alcohol by putting a drop on each pupil's tongue. State that the effect is always the same and varies only in degree according to the amount of alcohol in the liquor drank, and that the other organs through which the food passes are similarly affected. Explain the impossibility of quenching the thirst which results by drinking more of the liquor. State the effect of alcohol on the sense of taste.

State the immediate effects of chewing and smoking on persons unaccustomed to the use of tobacco. Lead children to observe the effects of chewing and smoking in causing a foul condition of the mouth, discoloration and decay of the teeth, in stunting the growth of the body and mind, and in the formation of other bad habits.

Lead pupils to be guided by the repulsion to using alcohol and tobacco which all feel at first and to so respect their bodies as to make it easy to avoid the temptation.

The moral lessons which can be based on the study of this sense are many and should be thoroughly impressed. Especially should the beginnings in wrong doing be earnestly treated.

The Sense of Smell. Experiments.

1. Close your eyes. Try to smell what is in this bottle. Teacher holds an open bottle of cologne a long distance from the pupils. What is the odor?

Close your eyes and mouth and try to smell it now. Teacher holds for an instant under the nose of each pupil a tightly stoppered bottle of cologne from which no odor is perceived. What is the odor?

Close your eyes, nostrils, and mouth and smell of this if you can. Teacher holds same bottle of cologne open under the nose of each pupil. What is the odor?

Close your eyes and mouth and smell. Teacher then holds the open bottle under the nose of each pupil. What is the odor?

Repeat these experiments using substances like cinnamon, clove. Use also odorless substances like quartz, tin, etc.

State what we can smell and when.

Pages 8-10 missing

2. Close your eyes and mouth. Smell the odor of this substance drawing in a very little air quietly. Now smell it drawing in much air vigorously. Which time did you perceive the odor most distinctly? Why?

State with which part of the nose we smell most delicately.

3. Teach the odors pungent, fragrant, spicy.

Care of the nose. Have pupils observe the effect of head colds on the sense of smell and on the power to breathe through the nose. Base all lessons on the care of the nose on the necessity of increasing the power to smell and of breathing through the nose.

Questions. Which animals have a keen sense of smell? How do you know? Tell stories of what you have seen and read in this connection.

Review.

With the skin we touch material objects.

With the eyes we see colors.

With the ears we hear sounds.

With the tongue we taste flavors.

With the nose we smell odors.

Impress upon your pupils that through the senses we get knowledge of things which will help or hurt us and that our duty is to choose and to do for ourselves those things which will help us and to assist others to so choose and act.

THE GENERAL STRUCTURE OF THE BODY.

Examine each pupil to find out what he knows about the structure of his own body and of the bodies of other animals. Teach him, if necessary, to distinguish and name each organ, to observe its position and prominent qualities.

These ideas should be gained by each pupil from the study of his own and of others' bodies, and from observation of other back-boned animals. These animals as wholes or in parts should be studied in the kitchen, in markets. The different structural parts should be studied in the school-room also to secure correctness and definiteness of ideas. Diagrams shou'd not be used until pupils have distinct ideas of the organs being studied.

The knowledge gained should be expressed at first by each pupil in his own language. When the ideas are correctly and definitely in mind simple descriptions including the more important facts may be developed. Simple diagrams showing mainly form in outline can be drawn with readiness by many pupils.

Every person who is to teach this subject and who does not know by personal observation the position, prominent qualities, and general structure of the organs of back-boned animals should without exception dissect some animal like the cat, dog, rat, rabbit, etc., or at least observe such a dissection. There is no better, surer, quicker, or simpler method of preparation for this teaching.

The Limbs and Walls. Frogs are excellent specimens for this work. Catch fifteen or twenty during the summer. Preserve them in alcohol and water (50 per cent. of each). To kill a frog for immediate use keep the frog in a tight jar containing two or three teaspoonfuls of ether for five or more minutes or immerse the frog in alcohol and water, 50 per cent., until life is extinct.

Skin. Specimens,—human body, frog.

Where is the skin? What is it of the body? Where is the skin thickest? Why? What grows from the skin? From what does sweat come? When? How should we care for the skin? When? Why? Remove the skin from a frog noticing where it is attached. What is fur? What is leather?

Muscle. Specimens,—human body, frog from which the skin has been removed, corned beef, six or eight inches of the lower end of a shin or shank of beef.

Feel the position and shape of the muscle on the front side of your upper arm while your arm is hanging by your side, also when your hand is clenched and your arm bent. Separate with your fingers one of the muscles on a frog's thigh. Cut off this muscle. Pick it apart lengthwise. Of what is it made? Pick apart a small piece of corned beef. The lean part of the corned beef is the muscle. Examine the end of the muscle on the shin of beef. Pick apart a portion of this muscle. Of what is the muscle of an ox made? Of what do you think our muscles are made? What is the use of muscles? Where are the muscles? How can we make our muscles strong and healthy? What weakens them?

Tendons. Specimens,—human body, frog from which the skin has been removed, six or eight inches from the lower end of a shank or shin of beef, a chicken leg.

Extend the fingers of the left hand forcibly. Feel of the cords on the back of that hand. Trace the cords from the wrist. Clench the left hand and bend it forward. Feel of the cords at the wrist. Trace them. Sit erect, then raise one foot from the floor and hold the leg rigid. Feel of the cords back of the knee. Find cords in other parts of the body.

Separate with the fingers a muscle in the calf of a frog's leg. Find in what the muscle ends? What is its color and shape? Of what is it made? Trace it to the farther end. What is the name of this cord?

Separate with the fingers if possible the muscle in the shank or shin of beef. What wraps the muscle and the parts of each muscle? Cut across the muscle in different places and notice the thickness of the wrapping substance at each cut. What becomes of the substance at the end of each muscle? What is its color? (Exposure to the air causes the change from white to yellow.) What is the shape and of what is it made? Is the tendon elastic or inelastic?

Study in a similar way the leg of a chicken.

What do you think the cords in your own body are? Describe them. Of what use are tendons?

Blood. Specimens,—human body, raw lean beef. What is the color of the blood? Where is it in the body? How do you know? What is the color of this piece of muscle? What gives it this color? Squeeze the piece of muscle hard. What makes the face flushed? pale?

Bloodvessels. Specimens,—human body, the heart* and beginning of the large bloodvessels of a sheep or calf, the heart and other chest organs† of a small animal, and the lower part of a shin or shank of beef. Procure also two small glass rods and a yard of cloth or tape about an inch wide.

Place your right hand on your chest like this. (Teacher shows.) What do you feel? What is moving? What is the movement called? (Question pupils to find who have seen a heart and what they know of it, then present the heart of a sheep or calf.) Of what is the heart made? What is its shape? Find large openings into the heart. Feel the thickness of the walls of the heart.

Feel the thickness of these tubes. Which has the thicker walls? (Teacher explains that the blood is forced out of the heart in spurts and is received into the heart quietly and steadily.) Through which tubes do you think the blood flows from the heart? Into the heart? Why? Name these tubes. Now examine these organs, a heart and lungs. Find the bloodvessels from the heart to the lungs. Find a large artery and veins not connected with the lungs. Which tube keeps its shape when empty? Which is flabby?

Separate the muscles on the shin (or shank). Cut the connective tissue with the point of a knife if necessary. Find two tubes deep-seated and near the bone. Which tube has the thicker walls? Name each tube. Push a glass rod into each tube, then trace the tube as far as possible.

Feel the beating of your heart. Feel the pulse at the wrist and ankle, on the neck and temples. (The teacher bares his left forearm.) Feel the pulse in my left wrist. Find the veins on my hand and arm and notice carefully how large they are. (Teacher then binds the tape tightly around the forearm next to the elbow and clenches the fist.) Now feel my pulse. What difference do you observe? What causes the difference? In which direction does the blood flow through the arteries? Notice the veins. What changes do you see? What causes them? In which direction is the blood flowing through the veins? (The teacher at this point should explain the subdivision of arteries into smaller arteries, their termination in capillaries, the union of capillaries into small veins and of small veins into large ones, and the passage of blood from arteries through capillaries into veins.)

Name the different blood vessels. Tell how to distinguish them. Of what use are they?

*It may be necessary to get a harslet. See Appendix, Harslet.

†See Appendix, Dissection of Circulatory System.

Nerves. Specimens,—human body, brain and spinal cord of pig or ox or of some small animal and the skull and spinal column of a similar animal, a frog having brain, spinal cord, and nerves exposed*, lower end of a shank of beef.

Who have had the teeth ache? ear-ache? a pain in an injured finger? What really ached? Who has ever hit his elbow in such a way as to cause intense pain for two or three minutes? What really pained you? With what do you really touch? see? hear? taste? smell? With what do you think? Where is it? How do you know? Who has seen a brain? a spinal cord? [The teacher here shows brain and spinal cord of some animal, a skull and spinal column (at least some of the vertebrae) of the same kind of animal if possible, explains the position of each in the body and tells pupils what to observe in the market.]

Observe in this frog the brain and spinal cord. Find where nerves leave the spinal column. Trace nerves from the spinal cord through the fore legs. Trace nerves from spinal cord to the hind feet. What do you observe on the back along each side of the spinal column? What come from them? (State how nerves extend from the brain to the eyes, nose, teeth, tongue, and cheeks: how others extend from the upper end of the spinal cord to organs in the chest and abdomen.) The brain, spinal cord, and such small nerve masses as you see beside the spinal column are called nerve centers. Why? The white cords extending from the nerve centers are called simply nerves.

Separate the muscles on a shin of beef and find a large nerve deep-seated, near the blood-vessels. What is its shape? Of what is it made? What is its color? Trace it as far possible.

Think of a use of the nerves to the eyes, to the nose, to the tongue, to the skin. Find a use of the nerves which extend to the muscles. (If the frog mentioned above was recently killed pressure with a pointed instrument on the nerves from the abdomen into the hind legs may excite muscular action. Explain if necessary that nervous force does not cease immediately with the loss of life.)

Where are the nerve centers and nerves of our bodies? What do you know of them?

Fat. Specimens,—beef suet, raw fat beef, cooked fat meat, the lower part of a shin or shank of beef.

Feel of the suet. Look at your finger. What kind of a substance is fat? Where is the fat in the piece of raw meat? in the cooked meat? Separate the muscles on the shin and find where the fat is. Think of three uses of fat. Where is the fat of our own bodies?

*See Appendix, Dissection of Nervous System.

Bones. Specimens,—human body, mounted (if possible) skeleton of a small animal, the following fresh bones—all the bones of a shoulder and of a leg of mutton or arm bone and end of shoulder blade in the rattle rand, all the bones of a shin with uncut joints, bones from lamb or veal.

Feel of the bones in different parts of your body. Feel of these clean bones. Feel of these beef bones. Where are the bones in our bodies? What is their use?

Find four kinds of bones according to form. What are marrow bones? Which bones of our bodies are marrow bones? Try to cut beef bones with a knife. Try bones from veal and lamb. Try to bend bones from mutton, from lamb. Like which are children's bones. What can children do to keep their bones in good shape?

Count your ribs, the bones of your arms, hands, legs, and feet.

Joints. Specimens,—as under *Bones*, a frog from which the skin and internal organs have been removed.

Feel of the bones of your arm. How many bones can you feel? What parts of the bones are united? Feel of the skull. How many bones do you feel? Count the bones of this skull. What parts of the bones are united? Why cannot bones be easily separated? What is the name given to unions of bones? What difference do you find between joints of arms and of the skull? What have you noticed about the bones of the heads of very small children?

Swing your arm in as many ways as possible. Swing your leg. Observe the shape of the ends of bones in the shoulder joint of the skeleton, from beef (arm bone and end of shoulder blade back of sticking piece), from mutton, and in the frog. Find how the bones move on each other. Observe the shape of the ends of the bones in the hip joint of the skeleton, from mutton, in the frog. Find how the bones move on each other. Name these joints from the shapes of the ends of bones forming them.

Bend your arm at the elbow. Feel of the ends of the bones. Bend the leg at the knee. Feel of the ends of the bones. Study the same joints in the skeleton, from beef, from mutton, in the frog. Name the joint from the motion.

Bend your hand at the wrist. Bend your foot at the ankle. Study the same joints in the skeleton and from beef. Name the joint from the motion of the bones.

Ligaments. Specimens,—as under *Bones* and *Joints*.

Pull the arm. Try to pull apart the bones from the beef, from the mutton. Why can you not pull them apart? What is it made of? Try to stretch it. What is its name? What is its use? What shapes can you find? Find how they are attached to the bones.

Cartilage. Specimens,—as under *Bones* and *Joints.*

Cut the bones apart at the joint. What is on the ends of the bones? How far down the bones does it extend? What is its color? How thick is it? Cut off a piece. Press on it and watch the mark. Bend a piece. What quality has it? Try to pull a portion into pieces. What quality do you find the substance has? Name the substance. Of what use is it? Notice the sticky substance in the joint. What is its use?

Review.

The *skin* is the thin outside covering of the body.

A *muscle* is a bundle of fibres used to move the parts of the body.

A *tendon* is a white fibrous cord or band in which a muscle ends.

The *blood* is the red liquid which is found in every part of the body.

The *bloodvessels* are the heart and the tubes through which blood flows to every part of the body and back to the heart.

The *nerves* are fibrous cords which extend from the nerve centers to all parts of the body enabling us to feel and move.

The *fat* is an oily substance packed between and around parts of the body to protect them and to give roundness and smoothness to the form of the body.

The *bones* are the very hard bodies which form the internal framework of the body.

A *joint* is the union of the surfaces of bones. Most joints allow motion.

A *ligament* is a fibrous, inelastic cord or band which binds the bones together at the joints.

The *cartilage* is a tough, elastic, bluish-white substance covering the ends of the bones in the joints.

Membranes (the skin and the wrapping substance of muscles, nerves, fat, etc.), tendons and ligaments, cartilage, bones, fat, muscles, nerves are called the *tissues.*

The Internal Organs.

Question pupils thoroughly to find who have seen any of the internal organs, what each has seen, where, and what each knows of them. Teach of the internal organs their general form, color, comparative size, and position. The position should be indicated by placing the hand over the organ and by statement. The use of each organ should be stated very simply.

Impress upon your pupils that these organs are familiar things easily seen at home, in the market, etc., and arouse interest in observing them there. Individual organs and groups of connected organs should be studied in the school-room. Dissection of an animal like a kitten or rabbit, if ever undertaken in the presence of younger pupils, should follow the study of the separate organs. Familiarity with the separate organs will tend to prevent the too vivid impressions sometimes made by the dissection of a whole animal.

Each pupil should express in simple, concise language what he knows *by personal observation* of the qualities and uses of each organ he has studied.

Tongue. Specimens,—human body, pickled lamb's tongue, an ox tongue.

Where is the tongue attached in the mouth? What is the color of the tongue in health? in sickness? Observe the surface of the tongue. Put a drop of vinegar on it and then look. In what ways can you move the tongue? Why? Answer by finding the direction of the fibres in a lamb's tongue. Of what use is the tongue?

Teeth. Specimens,—human body, teeth procured of a dentist.

How many teeth have you? What is their color? What causes the surface to discolor? What is the form of the front teeth? of the back teeth? Where do teeth decay most quickly? Why? How can you prevent it? What are the effects of *smoking* and *chewing* on the teeth?

Tonsils. Specimens,—our own bodies and those of friends.

Face the light and by means of a mirror observe the soft palate; then observe two fleshy bunches one on each side of the soft palate and a very little farther back. They are the *tonsils*. What do you observe on the surface of them? Why can you not swallow easily when you have a "sore throat"? Look at the tonsils in another's throat.

Pharynx or Throat. Specimens,—our own bodies and those of friends.

Face the light and by means of a mirror look through the opening below the soft palate into the pharynx or throat. What is the color of

it? What is the pharynx made of? Find by experiments even different openings into the pharynx.

Esophagus or Gullet. Specimens,—human body, gullet from a calf, sheep, or ox.

Drink a little cold water and feel its passage from the mouth to the stomach. Tell where you can feel the water. Examine the gullet of a calf or ox. Of what is it made? With what is it lined? covered?

Stomach. Specimens,—human body, stomach* with portions of esophagus and small intestine from a rabbit, cat or other small animal, tripe (not the honey-comb) which has been pickled.

Drink some cold water. Feel when the water enters the stomach, then place the hand on the body over the stomach. (Teacher then fills the stomach of a small animal with water and holds it in a position corresponding to that of the human body.) Observe the color (when natural color is retained.) Observe the shape. Find the larger end, smaller end. Toward which side of the body is the larger end? Through which tube do you think the food enters? leaves? Can you find any bloodvessels on the surface of the stomach? Examine the edge of tripe, (what is tripe?), then peel off layers of muscle. What is left?

(Teacher then makes proper explanation concerning the position, color, size, and gross structure of the human stomach.)

Small Intestine. Specimens,—human body, esophagus, stomach with small intestine* and mesentery from a rabbit, cat, or some small animal, portion of the small intestine of a pig.

If pupils for any reason know the position of the small intestine have them show position by placing their hands on their bodies.

Find the tube through which the food passes after leaving the stomach. Compare its length, size and thickness with those of the esophagus of the same animal. (Teacher holds up the small intestine by mesentery and explains that mesentery is fastened to the backbone.)

Fill the piece of the intestine from a pig with water, hold it up to the light and observe how thick it is and of what it is made. Observe what there is along one side of the intestine.

(Teacher makes proper explanations concerning the small intestine of the human body.)

Large Intestine. Specimens,—human body, adjoining portions of small and large intestines* of a pig.

Find where the small intestine enters the large intestine. Fill the large intestine with water and compare it with the small intestine in form and size. (Teacher explains position, form, size, length, and use of large intestine of human body.)

*See Appendix. Dissection of Digestive System.

Pancreas or Sweetbread. Specimens,—stomach, small intestine (10 or 12 inches), and pancreas (all connected) of a small animal, pancreas of a pig, human body.

Find what borders the part of the small intestine next to the stomach. What is its form? color? position? How is the pancreas held in place?

Study especially the pancreas of a pig. What is its form? In what is it wrapped? What is the color of the pancreas? Cut it open, notice color, bloodvessel. (Teacher makes necessary explanations of pancreas of human body.)

Liver. Specimens,—liver of ox or calf seen in the market, harslet of calf or sheep, human body.

Ascertain what is known of the organ. Direct pupils to observe the organ in the kitchen, in the market, to find its form, color, comparative size.

Study the harslet in the schoolroom if possible. Which is the front edge of the liver? the back edge? What difference is there in the edges? Where is the liver the thickest? What is its color? Compare the size of the liver with that of the pancreas or stomach. Cut through the liver and trace the large tubes. Where do the tubes enter the liver? Where is the gall bladder? Of what use is the liver? gall bladder? (show the bile.) Where is the liver with relation to the lungs? diaphragm? stomach? Place your hand over the liver of your own body. Describe its position. (Teacher makes the necessary explanations concerning the liver of the human body.)

Heart, Arteries, Capillaries, Veins. Specimens,—human body, harslet of a calf, sheep, or smaller animal.

Review carefully the points specified on page 10. Locate the heart with reference to the lungs and diaphragm. Find on which side of the breast bone and between which ribs the beat of the heart is felt. Count the number of beats in a minute before you run, then after a run. Find capillaries on the inside of a frog's skin.

Spleen. Specimens,—spleen of a calf or sheep. Teacher should explain form and position of the spleen in the human body.

Nostrils. Specimens,—human body, head of a calf or sheep.

What are the nostrils? Find by experiment if they are connected with each other. To what does each lead? (Teacher then shows the nose of calf or sheep which has been cut off three or four inches from the end of the jaw.) Find the shape of the nostrils. Of what use is this shape of the nostril? What grows within the nose? Of what use is it? Through what should we breathe? Why? What can we do to keep the nostrils in a healthful condition?

Pharynx. Review. See page 14.

Larynx. Specimens,—human body, larynx* and windpipe of a cat.

Feel of the hard body in the front of your neck. What is its name? Which way does it move when you swallow? Find the form of this larynx (from small animal.) Of what is it made? What is in it? What covers the box? What is attached to the bottom of the larynx? Swallow a little cold water and find where the esophagus is and why the water does notpass into the larynx. (Teacher should make further necessary explanations.) What can you do to keep your larynx in good condition? What part is affected when you are hoarse? What should you do then?

Trachea or Windpipe. Specimens,—human body, harslet of a calf or sheep, or of some anlmal.

Breathe in cold air. Trace it by feeling as far as possible. Name the parts through which the air passes. Where is the trachea? Place your hand on your arm.

Find of what this trachea is made. Cut off pieces. Where is it easiest to cut? What is the shape of one of the pieces cut off? Of what is it made? What closes the back part of the windpipe? Of what use are the pieces of cartilage? Observe the lower end of the trachea. What is back of the trachea? Of what use is the trachea?

Lungs. Specimens,—human body, trachea and chest organs of a small animal, or harslet of a calf or sheep.

Breathe as much air as you can. What holds the air inhaled? Breathe again and observe what parts of the body move as you breathe. Which part moves the most? Why?

Observe these lungs (of small animal) as I inflate them. What is the form of each? Observe closely the under side. What is their color? Observe the sharp edge of the lung to find of what it is made. How many are there? Name each. What are between the lungs? What touches the sides of the lungs? the bottom?

Find the trachea in this harslet. Cut open the left branch of the trachea and trace it as far as you can into the left lung. Find the bloodvessels connecting the heart and lungs. Make an opening in the artery and another in the vein connected with the right lung. Push glass rods through the bloodvessels into the lung. Follow the rods with a knife cutting open the bloodvessels and lung.

How should we breathe? Why? What kind of air should we breathe? Why? How can we get pure air at night? (Teacher should make necessary explanations and impress these and similar points thoroughly.)

*See Appendix. See Dissection of Respiratory System.

Diaphragm. Specimen,—harslet of a calf or sheep.

What is it? Where is it thickest? Where is it attached? (Teacher explains.) What does it separate? What organs touch the upper side? the under side? What is its position when the lungs are full? When nearly empty? What does it do to the stomach, liver, etc. when the lungs are properly filled with air? How should the clothing be worn in order that we may breathe properly?

Kidneys. Specimen,—kidney of a sheep*, or of a small animal.

In what is the kidney enclosed? Why? (Teacher removes the fat.) Feel of the kidney. What is its form? color? What closely covers the kidney? (Teacher should make proper explanations concerning the position and use of the kidney. Pupils should indicate the position of the kidneys by placing the hands properly on the "small of the back.")

Brain. Specimen,—brain of a calf†, or of a smaller animal.

Which is the large brain? In what part of the head is it? Which is the small brain? Where is it? What extends from the brain? Through what?

The Plan of the Body.

Specimens,—skeleton of an animal, human body.

The Cavities. The cavity of the skull and the spinal canal form the *back cavity*. The cavities of the mouth, neck, and trunk form the *front cavity*. The trunk is divided by the diaphragm into the chest and abdomen.

The Organs. The organs of the back cavity are the brain in the skull and the spinal cord in the spinal column. Of the organs of the front cavity the teeth and tongue are in the mouth; the pharynx and upper end of the esophagus, the larynx and upper part of the trachea are in the neck; the lower part of the trachea, the lungs, the heart, and the esophagus are in the chest; the stomach, intestines, liver, pancreas, spleen, and kidneys are in the abdomen.

The Arrangement. The vital organs are protected in large cavities in the body. The limbs are attached to the trunk.

Review.

Specimens,—all the separate organs of the various systems, the connected organs forming each system.

Distinguish and *name* separate organs.

*See Appendix. Dissection of Excretory System.

†See Appendix. Dissection of Nervous System.

Describe separate organs telling of each its relative position, general form, color, and peculiar qualities.

Locate each organ by placing the hand over it.

Associate the organs of each system in their proper order by tracing the passage of the food, the flow of the blood, the flow of the air, etc.

Name the organs in the chest, in the abdomen.

State briefly and simply the uses of some of the individual organs.

State important rules for the care of some of the individual organs.

Alcohol and Tobacco.

Lessons on the effects of alcohol and tobacco should be based upon the observations of the pupils. Effects which cannot be observed by them should be stated by the teacher. The effects may be studied in connection with each organ separately and again when the organs are grouped according to function. The following points are suggested for class work.

Skin. Observed by pupils.—Alcohol causes the face to become flushed. Habitual use of alcoholic liquors generally causes the nose and cheeks to remain very deeply flushed.

Muscles. Observed by pupils.—A drunken person has an unsteady, staggering gait. He is unable to perform delicate work. The muscles become weakened and tremble. His speech is indistinct because he cannot control the muscles of his tongue.

Blood. Stated by the teacher.—Alcohol changes the blood very quickly and it is then unable to nourish the body properly. Tobacco greatly lessens the power of the blood to nourish the body, causes paleness, and checks growth often to a marked degree.

Bloodvessels. Observed by the pupils.—The bloodvessels in the skin of the nose and cheek show plainly. Stated by the teacher.—The bloodvessels become weakened by the alcohol and are unable to contract properly. Alcohol causes the heart to beat very much faster and to do much extra and violent work. Tobacco weakens the heart causing it to lose a beat or two a minute in some cases.

Fat. Stated by the teacher.—Muscle in different parts of the body when affected by the continual use of alcohol changes to fat. Alcohol causes some persons to become larger, but at the same time they grow weaker.

Nerves. Observed by the pupils.—A drunkard loses control of his muscles. He loses his power to think well. His mind becomes weakened, and he cannot perceive, remember, or understand as well as he

did before drinking alcoholic liquors. A drunkard's disposition becomes fretful, quarrelsome, and often violent. Stated by the teacher.—Alcohol paralyzes and hardens nerve matter.

Mouth and Larynx. Observed by pupils.—A drinking man complains of a dry or parched mouth and throat, and the more alcohol he drinks the worse it feels.

Tobacco, whether smoked or chewed, causes at first an undue flow of the saliva. This effect is followed by a feeling of dryness in the mouth and throat, which often leads to the drinking of alcoholic liquors. Habitual smokers are often troubled with "smoker's sore throat," which is accompanied by a cough and sometimes indistinctness of speech and deafness. Smoke of cigarette covers is especially injurious because of the very great irritation produced in the throat and larynx.

Stomach and Intestines. Stated by the teacher.—A drinking person is troubled with loss of appetite and indigestion. The stomach is so flushed with blood as to be unable to perform its work properly; therefore the body is but partly nourished. The intestines are similarly affected.

Tobacco, whether smoked or chewed, at first causes severe sickness at the stomach, showing thereby its injurious effect. Because of injury to the blood by tobacco the digestive power of the stomach is weakened.

Liver. Stated by the teacher.—Alcohol in some persons causes the liver to enlarge and afterward to shrivel. The surface then is very rough and is called "hob nailed." In other persons the liver is caused to change to fat and enlarges to an immense size.

Lungs. Stated by the teacher.—The wastes of the body are very much increased by alcohol and the lungs have much extra work to do in throwing off waste matter. Persons in the habit of drinking alcoholic liquors are very liable to frequent lung colds and attacks of pneumonia. Tobacco smoke irritates the lining membrane of the lungs and weakens them.

Kidneys. Stated by the teacher.—Alcohol causes very harmful changes in the kidneys. Some parts of the waste matter are not taken from the blood while certain nourishing parts are removed from the body thereby weakening it.

Brain. Observed by pupils.—A drunkard's senses are much injured. His powers to think become permanently weakened. Stated.—Insanity often results from excessive drinking.

THE NEEDS OF THE BODY.

The most important and the most obvious facts should be considered under this topic. The facts which pupils know by experience, by observation of others, from home teaching indicate the kind and range of work.

As many illustrations as possible should be drawn from the personal experiences of the pupils and from their observations of other people. The teacher should add further necessary illustrations. Then pupils should be led to perceive effects, to compare injurious effects with the needs, and to make correct conclusions.

What I can do.	What I need.
Eat and drink;	food.
Breathe;	air.
Become hot or cold;	clothing.
Cleanse my body and clothes;	remove wastes.
Work and play;	exercise of body.
Touch, see, hear, taste, smell, think;	exercise of mind.
Sit, lie down, sleep;	rest of body and mind.

Food.

Why food is needed. Call attention to the needs of boys and girls, to the needs of every person, to the feeling of warmth which follows eating.

Reading,—"How to Keep Well," pp. 3, 51, 52.

What a food is. Pupils can define food from their knowledge of the needs of the body.

A food is a substance which is eaten or drunk for the growth, repair, heat, or strength of the body.

Is *alcohol* a food? Reading,—"Child's Health Primer," pp. 86-91. "Hygiene for Young People," pp. 77-85. "How to Keep Well," p. 143.

Kinds of food. Foods for the growth and repair of the tissues are called *tissue-forming* or flesh-making foods. Foods for keeping up the temperature of the body are called *heat-producing* or fuel foods. Make a short list of tissue-forming foods, another of heat-producing foods.

Reading,—"Child's Health Primer," pp. 74-77, 85. "Hygiene for Young People," pp. 67-74. "How to Keep Well," pp. 53-57.

Sources of foods. Have pupils make lists of what they have seen used for food and from what each was obtained. Lead them to a classification of the foods and sources.

Beef, ox.		hen.	cod.	lobster.
Veal, calf.	Poultry	chicken.	mackerel.	shrimp.
Mutton, sheep.	and	turkey.	halibut.	crab.
Lamb, lamb.	Game.	goose.	herring.	clam.
Pork, swine.		partridge.	haddock.	oyster.
Dairy products.	Eggs.	quail.	smelt.	scallop.
Animals—Quadrupeds.		Birds.	Fishes.	Shell-fish.

In a similar way lead pupils to classify foods from plants, cereals, garden produce, fruits. Have the mineral foods and their sources named. Miscellaneous—Have the condiments and artificial drinks named. Are they foods?

Reading,—"How to Keep Well," pp. 57-67. "Child's Health Primer," pp. 71-74. "Hygiene for Young People," pp. 65-66.

Quality of food. Food should be fresh, mature, nutritious, easily digestible, adapted to the season, and adapted to the age.

Reading,—"How to Keep Well," pp. 87, 88. "Hygiene for Young People," p. 75.

Quantity of food. The quantity of food eaten should depend on the age, health, amount of exercise, the season, and the kind of food used.

Reading,—"How to Keep Well," pp. 85, 86.

Time of taking food. Food should be eaten at regular intervals. When the body or mind is tired one should rest before eating. One should not begin severe exercise of body or mind immediately after eating.

Reading,—"How to Keep Well," pp. 89, 90.

Manner of taking food. Food should be well chewed, eaten slowly, taken without much drink. Food should be neither too hot nor too cold, and should not be highly seasoned. Conversation and pleasantry should accompany our eating.

Reading,—"How to Keep Well," pp. 91, 92.

Air.

Why air is needed. Pupils should determine the need by comparing the body with a steam engine.

The engine to do its work requires repair, heat, and force; the body to do its work requires growth, repair, heat, and force. Into the engine is put fuel; into the body is taken food which is digested and distributed. To produce heat and force in the engine the fuel is burned; to produce growth, repair, heat and force in the body the food after it has been digested and distributed is burned, though slowly. (The fuel under the boiler does not repair the engine; food

taken into the body furnishes material for growth and repair.) To keep the fire in the engine burning air is necessary; to keep up the burning in the body air is necessary. The oxygen of the air is the part that supports combustion.

The body needs air (oxygen) to keep up the slow burning by which growth, repair, heat, and force are produced.

Why we breathe. Continue the comparison.

In the engine the wastes are ashes, smoke, and gas. (Experiment. Fasten wire to short piece of candle. Light candle and lower it to the bottom of a wide mouthed jar. Breathe slowly, steadily through a tube reaching to the bottom of the jar. Observe what happens. Infer what this gas is to the body.) In the body one of the wastes is a gas, called carbonic acid gas.

We breathe in air containing oxygen; we breathe out air containing carbonic acid gas.

Reading.—"How to Keep Well," pp. 3, 51. "Our Bodies," pp. 1, 2, 51.

How we should breathe. Through what do you breathe when sitting? standing? walking? running? working? playing? sleeping? Through what should you breathe? Why? When?

1. Place your hands flat on your chest and find what it does when you inhale and exhale, both slowly and quickly. 2. Have one place a tape around your trunk just under your arms and measure the girth of your chest when you have exhaled all the air possible; when you have inhaled as much as possible. When is your chest largest? when smallest? How does your chest move when you inhale? exhale?

Think of the appearance, position, and action of the diaphragm. When is the diaphragm arched high into the chest cavity? When is it flattened? (If pupils do not remember have them examine the lungs and diaphragm of a small animal.) How does the diaphragm flatten? What does it do to the organs of the abdomen?

1. Place your hands flat on the front of the abdomen and find what it does when you inhale and exhale, both slowly and quickly: when you blow; when you cough. 2. Have some one measure the girth of your waist when you have exhaled all the air possible; when you have inhaled as much as possible. When is the girth of the abdomen greatest? when least? How is the girth lessened? What does this do to the internal organs of the abdomen? to the diaphragm?

State clearly the action of the trunk in breathing. What should be the position of the body? What are the effects of a coat or dress which is tight across the chest? What are the effects of clothing which is tight around the waist? How should we wear all our clothing?

Reading,—"Child's Health Primer," pp. 100, 101. "Hygiene for Young People," pp. 115, 117.

Pure and impure air. What is pure air? What is impure air? What causes the air within doors to become impure? How can we keep the air in our homes pure? What causes air out-of-doors to become impure? How is the atmosphere purified?

Reading,—"Hygiene for Young People," pp. 118, 119. "How to Keep Well," pp. 121, 122.

Effects of breathing pure air, impure air. Have pupils state observed effects in the following order.

Appetite, digestion. Flow of the blood. Activity of the nostrils, chest, lungs, abdomen; amount of air inhaled, amount of waste exhaled; pleasure. Position, carriage, movement, strength, endurance. Senses, thinking, vigor. Color and activity of the skin.

Reading,—"How to Keep Well," pp. 120, 121, 123, 124.

Ventilation. Why is ventilation necessary? What is ventilation? How does pure air get into our homes? How is impure air removed from our homes? Explain how you can use windows, doors, and a stove or fireplace to ventilate the sitting room. Explain how you can ventilate your chamber. How can the air in the cellar be kept pure?

Reading,—"How to Keep Well," pp. 125, 125. "Hygiene for Young People," pp. 117-122.

Drainage. Why is drainage necessary? Prove that the ground contains air, water. How is the material near the surface of the earth arranged? Through what will water soak? Where does the water which collects in the well come from in each of the following cases? Draw diagrams of each case. 1. The well is dug through level layers of loam, sand, and into loose gravel. 2. The well is dug through level layers of loam, gravel, sand, down to rock. 3. The well is dug through inclined layers of loam, hard gravel, sand, down to rock. What is a leaching cesspool? What becomes of the sewage which collects in a leaching cesspool in each of these cases? Draw diagrams of each case. 1. The cesspool is dug in level layers of loam and sand. 2. The cesspool is dug through level layers of loam and sand down to hard gravel or rock. 3. The cesspool is dug through inclined layers of loam, sand, down to hard gravel or rock. How can well-water become polluted? How can the impurity be detected?

Where should sink-water be emptied? What should be done with vegetable or animal refuse? Where should the cesspool be placed? Why? Where should the privy be placed? Why? How can receptacles for sewage be kept in good condition? Where should the barn

be placed? What kind of water should horses and cattle drink? What kind of water do they drink if the well is under or beside the barn cellar? Why?

Clothing.

Why the body is warm. Review the comparison of the body with a steam engine and emphasize the production of heat by the slow burning of the body. How does the body become hot? cold?

Reading,—"Child's Health Primer," pp. 115, 116. "Hygiene for Young People," pp. 149, 150. "How to Keep Well," pp. 138-141. "Our Bodies," pp. 120-122.

Why clothing is needed. Clothing is needed to keep the body warm and to protect it from injury.

Reading,—"How to Keep Well," pp. 142, 142.

Kind of clothing. The material, texture, and color of the clothing should be adapted to the health and occupation of the person, and to the season and climate.

Reading,—"Child's Health Primer," p. 117. "How to Keep Well," p. 142.

Amount of clothing. The amount of clothing may be increased by changing thin garments for thick ones or by putting on extra garments. The amount worn should depend on the age, health, and occupation of the person, and should be adapted to the season and climate.

Reading,—"Hygiene for Young People," p. 151.

How clothing should be worn. All garments should be worn loosely and supported from the shoulders. Outside garments like hats, scarfs, coats, leggings, and rubbers should not be worn within-doors. No part of the body should be unduly wrapped or exposed.

Reading,—"How to Keep Well," p. 143.

Removal of Wastes.

The wastes. The principal wastes of the body are undigested food, urine, sweat, and carbonic acid gas.

The sources of waste. Some parts of the food eaten cannot be digested and at times more food is eaten than can be digested.

The wastes from combustion in the engine are ashes, water (which passed off as vapor), and gas. A piece of dried beef when burned produces heat and changes to ashes (solid matter), to water (which is evaporated), and to carbonic acid gas. So beef which has been eaten and digested is burned in the body. Here the beef in burning not only produces heat and changes to tissue, but also changes to wastes of which the principal are minute solid particles, water, and carbonic acid gas. These wastes are collected by the blood.

Reading,—"Our Bodies," pp. 192, 193, 195.

How wastes are removed from the body. The *undigested* food passes from the small intestine through the large intestine and then from the body. The *urine* which consists principally of water and some solid matter is filtered from the blood by the kidneys, from which it passes through two long tubes, one from each kidney, to the bladder and then out of the body. The *sweat* which consists chiefly of water and solid matter like salt, is filtered from the blood in the skin and then flows through very fine tubes out upon the surface of the body where the water evaporates. The *carbonic acid gas* is taken from the blood by the lungs and then is breathed out of the body.

Reading,—"Child's Health Primer," pp. 103, 104. "Hygiene for Young People," pp. 143, 144. "How to Keep Well," pp. 131, 132. "Our Bodies," pp. 131, 132.

Effects of not removing the wastes. Use many illustrations in showing the effects of infrequent and irregular removal of each form of waste from the body.

The wastes of the body are poisons. If they are retained in the body the blood from which the wastes were taken reabsorbs some of the waste material. The whole body thus becomes poisoned, loses strength, power to endure, and is then more liable to disease.

Cleansing the skin. The skin on every part of the body needs frequent cleansing. Why? The hands, face, feet, scalp, and other parts which perspire freely require very frequent and careful bathing. Why?

Reading,—"Child's Health Primer," pp. 105, 106. "How to Keep Well," pp. 133, 134. "Our Bodies," p. 133.

The different kinds of baths according to temperature are hot, tepid, and cold; according to the amount of water used are hand or dip baths. The value of a bath depends on its final effects.

The kind and frequency of bathing depend on the age, occupation, health, condition of the body, the activity of the skin of the individual, on the time when taken, and on the season.

Reading,—"Hygiene for Young People," pp. 146, 153. "How to Keep Well," pp. 136, 137. "Our Bodies," pp. 134, 135.

Cleansing the clothing. Outside clothing should be aired, shaken, and brushed. Underclothing or any garment worn next the skin should be aired during sleep, shaken before being put on again, and washed frequently. Bed clothing should be shaken and thoroughly aired before the bed is made up for the day, and washed frequently.

The frequency of washing the clothing depends on the frequency of bathing the body, on the occupation, the condition of the body, the activity of the skin, and on the season.

Reading.—"Child's Health Primer," pp. 105-107. "Hygiene for Young People," p. 152. "How to Keep Well," p. 143. "Our Bodies," p. 137.

Exercise.

What exercise is. Exercise is exertion of the body or mind.

Why exercise is necessary. Exercise is necessary to secure health, strength, and skill. The power to use properly and skilfully any part of the body can be increased only by judicious exercise of that part.

Reading.—"Child's Health Primer," pp. 24-31, 95. "How to Keep Well," pp. 44, 45. "Our Bodies," p. 45, 46.

Kinds of exercise. Both body and mind can be exercised in work and in play.

Work. Work is exercise of the body or mind in performing some task. Every one should work with his body and his mind. The kind, amount, violence, and time of work should be adapted to the age, health, strength, and needs of the individual.

Play. Play is exercise of body or mind for amusement. Every one should play with his body and his mind. The kind, amount, violence, and time of play should be adapted to the age, health, strength, and needs of the individual, and to the season.

Reading.—"Hygiene for Young People," pp. 60, 91. "How to Keep Well," pp. 46-48. "Our Bodies," pp. 46-48.

Rest

What rest is. Rest is cessation from exercise of the body or mind, or both.

Why rest is necessary. Rest is necessary for the growth and repair of tissue, the renewal and increase of strength both of body and mind.

Reading.—"How to Keep Well," pp. 155, 156. "Our Bodies," pp. 152, 153.

Kinds of rest. Either the body or the mind or both may be rested by a change of exercise or by sleep.

Amount of rest. The amount, kind, and time of rest should be adapted to age, health, occupation, and needs of the individual, and to the season and climate.

Reading.—"How to Keep Well," pp. 157, 158. "Our Bodies," pp. 153, 154.

Review.

State the needs of the body.

State the topics considered in the study of each need.

State in detail what you know of each need.

State your duty which arises from knowledge of your needs.

State the use you make of the knowledge of your needs.

THE DIFFERENT SYSTEMS.

What to Teach.

More details of structure, function, and care should be included, the harmony of function and structure should be perceived, and the duty of caring for the body felt and performed.

Method of Work.

The method of study of individual organs in a system is essentially the method followed in the study of the General Structure, pp. 8 and 14, and the Needs of the Body, p. 21.

Organs should be observed more thoroughly, pictures and diagrams should be studied carefully, and books should be read more constantly to supplement the other work.

The expression of knowledge by drawing diagrams should accompany the study of each organ and each system. The knowledge gained should be expressed correctly and simply by each pupil in his own language. The more important facts should be expressed in very definite, concise sentences constructed by the class with due attention to choice and arrangement of words. These facts should be memorized verbatim.

Introductory Definitions.

Organ. Ill. Stomach, heart; eye, hand.

An organ is a part of living body which does a special work for the life or well-being of the whole body.

System. Ill. Mouth, teeth, tongue, pharynx, esophagus, stomach, intestines, pancreas, liver.

A system is a series of connected organs which together do one work.

Function of an Organ or System. Ill. Eye, seeing; ear, hearing; digestive system, digestion.

The function of an organ or system is the special work which it does.

Membrane. Specimens,—human body,—skin, covering of tongue, linings of the mouth, esophagus, trachea, etc.; other animals,—covering of lungs, of stomach, lining of the chest and abdomen, etc.

A membrane is a spread out tissue.

The mucous membrane is the thin membrane which covers all internal free surfaces to which air is admitted.

The serous membrane is the thin membrane which covers all internal free surfaces to which air is not admitted.

Gland. Specimens,—human body, salivary glands* of a rodent, liver and bile from a calf or ox, pancreas of a pig, tripe, kidney of a sheep.

Find how much pupils recall of each organ. Have pupils observe the organs for all needed facts not known. Supplement the work by use of diagrams.

Ill. Salivary glands, saliva, duct to the mouth. Observe the organ in the animal. Learn the position of the organ in the body by diagrams. "Human Body and Its Health," p. 105. "Our Bodies," p. 69. "Essentials of Anatomy, Physiology, and Hygiene," p. 54. Place the hands on the proper parts of the face. The saliva is made from the blood.

Consider in a similar way each of the following: Liver, bile, duct to small intestine. "Human Body and Its Health," p. 208. "Our Bodies," p. 72. "Essentials of Anatomy, Physiology, and Hygiene," pp. 63, 83.

Gastric glands, gastric juice, ducts to the surface of the mucous membranes of the stomach. "Human Body and Its Health," p. 107. "Essentials of A, P, H," p. 59.

Kidneys, urine, ducts to the bladder. "Human Body, Brief Course," p. 262.

Sweat glands, sweat, ducts to the surface of the skin. "Human Body and Its Health," pp. 157, 159. Anatomy, Physiology, and Hygiene, Walker, p. 42.

A *gland* is an organ which separates from the blood a liquid and carries it to some other part of the body.

THE DIGESTIVE SYSTEM.

The Organs.

The Alimentary Canal. Specimens,—human body; esophagus, stomach, small intestine, large intestine, liver, and pancreas with unbroken connection from a small animal. If the unbroken series cannot be procured use the separate organs (from the same animal if possible) and supplement their use by diagrams.

What is it? How long is it? Where does it begin and through what part of the body does it extend? What covers the whole tube? What lines it? What is between? Name the organs forming this tube. What is the tube called? Why?

Reading.—"Hygiene for Young People," pp. 88, 89. "Human Body and Its Health," pp. 98, 99. "Our Bodies," p. 65. "Human Body, Elem. Course," pp. 99, 100.

*See Appendix. Dissection of Digestive System.

The Glands. Specimens,—as above; also the salivary glands of a rodent (exposed by laying back the skin on the lower jaw); tripe; bile from an ox or calf. Diagrams,—see topic Gland, p. 30.

What large glands are attached to the alimentary canal? In what parts of the mucous membrane of the canal are there minute glands necessary to digestion?

Mouth. Specimen,—human body.

What is the mouth? What encloses it? Name the parts of the mouth. Describe each part. Name the organs in the mouth.

Tongue. Specimens,—human body, a pickled or canned tongue.

What is the tongue? Where is it attached? With what is it covered? Observe the upper surface of the tongue, then put a drop of vinegar on the surface and observe; describe the surface. Cut across the pickled or canned tongue making thin slices, and when dried pick apart the slices to determine the direction of the fibres; describe their directions; draw a diagram of them.

Teeth. Specimens,—teeth in the mouth, the skull* of a small animal, human lower jaw, human teeth procured of a dentist.

Direct pupils to observe while at home the arrangement, number, parts and shapes of their teeth. At school each pupil or group of pupils should have for study an incisor, cuspid, bicuspid, and molar from each jaw; also a broken tooth for study of structure. The skull and lower jaw should be at convenient places for study. Several small mirrors should be at hand.

What are the teeth? How are they arranged in the mouth? How is each tooth held in place? (Observe your own teeth and those in the skull.)

How many external parts has a tooth? (Observe single whole teeth and your own.) Describe each part. Draw an outline of a tooth.

Of what is a tooth composed? (Study the broken tooth.) Where is each part? Name each part. Which part of each of your teeth is visible? What is the pulp of a tooth? Where is it? Draw a diagram showing the structure of a tooth.

Describe the different teeth telling of each the form of the crown, number and peculiarities of roots, its use, and name.

What is meant by the milk or temporary set of teeth? What teeth and how many does this include? What is meant by the permanent set? How many teeth of each kind and how many all together are there in this set?

*See Appendix. Preparation of Bones.

Reading,—"Hygiene for Young People," pp. 89-91. "How to Keep Well," pp. 70-72. "Human Body and Its Health," pp. 102-104. "Our Bodies," pp. 66-68. "Human Body, Elem. Course," pp. 101-104.

Salivary Glands. Specimens,—human body; salivary glands* of a rodent. Diagrams,—"Our Bodies," p. 69. "Human Body and Its Health," p. 105. "Essentials of A, P, H," p. 54.

How many pairs of salivary glands are there? Where is the largest pair? Place your hands on this pair. Hold the lower jaw firmly against the upper; feel a cord-like body passing from the gland across the muscle of the jaw to the middle of the cheek. This is the duct from the gland. Find on the inside of the cheek opposite the second molar tooth the opening of this duct. What is the disease called the "mumps"?

Where is the pair of glands next in size? Where is the smallest pair? Where do their ducts open into the mouth? Dry your mouth with a towel or handkerchief; then open the mouth, curl back the tongue and watch by means of a mirror the saliva collect on the floor of the mouth.

Reading,—"Human Body and Its Health," p. 105. "Human Body, Elem. Course," p. 106.

The teacher can give quite a vivid idea of a salivary gland by comparing it with a bunch of grapes. Each grape must be imagined to be very minute, to have no pulp, its stem to be hollow; the liquid to flow from the grape skins out through the smaller stems into and through the main stem; and the color to resemble that of the pancreas (pale pink).

Pharynx. Specimens,—our own bodies and those of friends. Diagrams.—"Our Bodies," p. 71. "Human Body, Elem. Course," p. 111. Anatomy, Physiology, and Hygiene, Walker, pp. 79, 80.

Face the light and by means of a mirror look through the opening below the soft palate into the pharynx or throat. What is it made of? What is its shape? (Study diagrams.)

To what is the top of the pharynx attached? the back? (Study diagrams.) What are in front of the pharynx? How far through the neck does the pharynx extend? What is attached to the lower end of the pharynx?

Find by experiments seven openings into the pharynx.

Reading,—"Human Body, Elem. Course," p. 110.

Esophagus. Specimens,—human body, harslet of a calf or sheep, gullet of an ox. Gullet in four parts,—1st, in natural condition; 2d, slit open to show layers more plainly; 3d, serous membrane com-

*See Appendix. Dissection of Digestive System.

pletely removed to show the direction of the outside layer of fibres; 4th, serous membrane removed and outside fibres laid back to show the direction of the inner layer.

What is the esophagus? Where does it begin? (See diagrams under Pharynx.) Through what does it extend? (Drink a little cold water and feel its passage.) What does it enter?

What is back of the esophagus? (See diagrams.) To what is the esophagus attached in front in the neck and upper part of the chest? (Study harslet.) How it it attached? Where is the esophagus in the lower part of the chest? Observe where the esophagus passes through the diaphragm. How far from the diaphragm does the esophagus enter the stomach. Draw a diagram showing the relative position of the esophagus.

Of what is the esophagus composed? (Study 1st and 2d parts of the gullet of ox.) How many layers of muscular fibres are there? What is their relative direction? (Study 3d and 4th parts.) Teacher explains that, approximately, the outside fibres are longitudinal and inside fibres are circular. Draw a diagram showing the structure of the esophagus.

Stomach. Specimens,—human body; alimentary canal* from a small animal; pig's stomach, opened along the short curve; pickled tripe.

Drink some cold water. Feel when the water enters the stomach and then place the hand on the body over the stomach. What is the stomach? (Teacher fills the stomach of a small animal with water and holds it in a position corresponding to that of the human stomach.) Observe the shape of this stomach. Compare with the shape of the human stomach (see diagram "Human Body and Its Health," p. 108. "Our Bodies," p. 81. "Human Body, Elem. Course," pp. 112, 115.) How much does a human stomach of average size contain?

Find the opening from the esophagus into the stomach, from the stomach into the intestine. (Study specimens and diagrams.) Feel the thickness of the muscles around these openings. Find the large pouch of the stomach, the small pouch; the short curve, the long curve. (Study specimens, then diagrams. "How to Keep Well,', pp. 77, 78. "Human Body, Elem. Course," p. 115.) Draw a diagram of the stomach.

Where in the abdomen is the stomach? (Drink a little cold water.) How is it placed? Where is the large pouch? Where is the small pouch? (Study diagram.) "How to Keep Well," pp. 9, 81. "Human Body and Its Health," p. 108. "Essentials of A, P, H," p. 51.) Draw

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layer extend? Trace carefully over the short curve and on the great pouch to find their relation to the last layer. Hold up to the light, inside of stomach toward you. Replace as before. Draw in another outline lines to represent the distribution and direction of these fibres.

Name each layer from the direction of its fibres. Describe each layer telling its relative position, the direction and distribution of its fibres. Represent all the layers in one diagram. (See diagram, Anatomy, Physiology, and Hygiene, Walker, p. 81.)

Small Intestine. Specimens.—alimentary canal and great omentum from a small animal, the intestines coiled in the mesentery; 4 feet of the intestine of a pig cut from the part adjoining the stomach and divided into three lengths—*a*, 6 inches, turned inside out and kept in a bottle containing alcohol and water; *b*, 2 feet: *c*, 6 inches.

What is the small intestine? (Study small intestine of the alimentary canal.) How long is the small intestine of the human body?

Where in the abdomen is the small intestine? (See diagram, "Our Bodies," pp. 8, 81.) What organs touch it from above? behind? What borders it? How is the small intestine supported? (Study alimentary canal, etc.) What covers it in front? (See diagram, "Human Body, Elem. Course," p. 7. Examine great omentum.) From what does it hang? Examine the long curve of the stomach.

How many coats has the small intestine? (Study specimen *b*.) Name the coats. Observe the distribution of bloodvessels. (Fill specimen *b* with water and hold up to the light. Study diagram, "Essentials of A, P, H," p. 87.

Cut open specimen *c* along the inside curve and spread it out inside uppermost in a shallow dish containing a little water. Observe the direction of the folds or ridges of the mucous membrane. (These are easily seen in a fresh specimen which has been gently cleaned.) Study diagram, "Human Body, Elem. Course," p. 118. Compare the length of the small intestine with the length of the mucous membrane.

Observe specimens *c* and *a* with a magnifying glass. Study diagrams, "How to Keep Well," p. 82. "Human Body and Its Health," p. 111. "Our Bodies," p. 77. "Human Body, Elem. Course," p. 119. "Essentials A, P, H," p. 88. Anat., Phys., Hy., Walker, p. 84.

Study diagrams of glands. "Essentials of A, P, H," p. 88. Anat., Phys., Hy., C. Cutter, p. 114.

Tear the mucous membrane from the serous membrane of specimen *c*. Observe the position, direction, and distribution of the muscular fibres exposed.

Reading.—"Our Bodies," pp. 74, 79. "Human Body, Elem. Course," pp. 116, 118.

Large Intestine. Specimens,—adjacent parts of small and large intestines, connection unbroken, from a pig.

What is the large intestine? Fill with water.) Compare the length of the small and large intestines. How long is the large intestine of the human body? Compare the size (diameter) of the small and large intestine.

Where in the abdomen is the beginning of the large intestine? Trace its course and tell what organs it touches. Study diagrams, "How to Keep Well," pp. 9, 70, 85. "Human Body and Its Health," pp. 99, 108. "Our Bodies," pp. 8, 66, 81. "Human Body, Elem. Course," p. 115. "Essentials of A, P, H," p. 51. How is the large intestine held in place?

Observe the position, direction, and distribution of the muscular fibres. Account for the pouched appearance.

Observe where the small intestine enters the large intestine. Observe on the inside how the waste material is prevented from returning. See diagram, "Essentials of A, P, H," p. 80.

Reading.—"Our Bodies," p. 80. "Human Body, Elem. Course," p. 119.

Liver. Specimens,—alimentary canal, liver, pancreas, and blood-vessels with unbroken connections from a small animal; harslet of a sheep or calf.

What is the liver? its color? Press on it. Hold it up by the esophagus and trachea, then observe the right and rear parts, the left and and front parts. Compare the liver with other glands as to size.

Where in the abdomen is the liver? What organs does it touch? How is it held in place? Study the specimens, then diagrams, "How to Keep Well," pp. 9, 85. "Our Bodies," pp. 8, 81. "Human Body and Its Health," p. 108. "Essentials of A, P, H," p. 51.

What is the gall bladder? its position and attachments? Cut open the large end, collect the bile in a bottle and keep for future use. Push a knitting needle through the gall bladder into the duct leading from it, into the duct joining it from the liver, and through the common duct to the intestine. Slit the intestine and find the point of entrance of the duct. See diagrams, "Our Bodies," pp. 72, 81. "Human Body and its Health," p. 108.

Reading.—"How to Keep Well," pp. 80, 81. "Our Bodies," pp. 74, 75. "Human Body, Elem. Course," p. 116.

For further study of the vessels of the liver use first the liver con-

nected with internal organs, then the liver of the harslet. Study diagram, "Essentials of A, P, H," p. 83.

Find the point of entrance of the bloodvessels on the under side of the liver. Find a large vein (portal vein) made by union of veins from stomach, spleen, (pancreas,) and intestines. Find an artery (hepatic) entering beside the vein. (If necessary slit the aorta along its rear side; find the first large opening below the diaphragm; trace this branch (cœliac axis) by probing and cutting until its subdivision into three smaller branches is found; find with the knitting needle the branch extending to the liver.) Find a large vein (vena cava ascending) passing through the rear border ot the liver; cut a slit in it, and observe the veins (hepatic veins) entering it from the liver.

Cut off a portion of the liver and into the ends of the tubes exposed push knitting needles, thereby tracing the tubes to their exits from the organ.

Draw a diagram showing a section of the liver through the point of entrance of bloodvessels, and the bile ducts.

Pancreas. Specimens,—alimentary canal with liver, pancreas, and bloodvessels having unbroken connections; pancreas of a pig.

What is the pancreas? its form? See diagram, "Essentials of A, P, H," p. 81. What is its color? comparative size?

Where in the abdomen is the pancreas? What organs touch it? How is it attached?

Compare in structure with the salivary glands. (Teacher explains.) Find the duct in the pig's pancreas. Into what does the duct empty? See diagrams, "Our Bodies," p. 72. "Essentials of A, P, H," p. 63. Find opening of duct into the small intestine. What is secreted by the pancreas?

Reading,—"Our Bodies," p. 75. "Human Body, Elem. Course," p. 117.

The Functions of the Organs.

Foods.

Why food is needed. Review carefully.

What a food is. Review carefully.

Kinds of foods. Review carefully and in addition show these tissue-forming foods,—albumen from eggs, meat, blood, cereals, and vegetables; fibrin from lean meat, and blood; casein from milk; gelatine from meat and bones; gluten from cereals: heat producing foods,—fat from beef, mutton, pork; oils; starch from grains, and roots; sugar from the cane, grape, and milk;—also salt and other mineral substances. For preparation see "Our Bodies." pp. 239-242, Exp.26-38.

Necessity of a change in the condition of the food. Recall the structure of the alimentary canal. Observe the condition of the food taken into the mouth. Recall how food is distributed. What must take place before the food can be distributed?

Cooking. Name the common articles of food. Which require no cooking? Which require cooking? Observe the appearance and taste of dry oatmeal, of well cooked oatmeal; of dry starch, then of well cooked starch; of dry wheat flour, then of unsweetened wheat bread. Observe the appearance and taste of raw meat and the degree of difficulty with which the fibres can be pulled apart, then of thoroughly cooked meat. What two great effects of cooking food? Why do some foods require cooking?

Digestion is breaking apart and changing the composition of food to make it easily soluble.

Reading,—Science Primer, Phys, p. 115, ¶50.

Mouth Digestion.

Chewing.—Which jaw is movable? in what directions? Find what each motion does to food in the mouth. What do we know from the sensitiveness of the teeth of the condition of the food? What is the action of the tongue in chewing? of the cheeks and lips? Why is chewing necessary?

Saliva.—Describe the saliva. When is it secreted? Upon what does the amount secreted depend? Learn the functions of the saliva by chewing a cracker; by putting sugar and salt in the mouth; by chewing a crust of bread. What other use has the saliva?

Reading,—"How to Keep Well," p. 73. "Our Bodies," p. 69. "Human Body, Elem. Course," pp. 106-108.

Swallowing.—Observe the action of the tongue as you swallow food. Read concerning the action of the pharynx and esophagus, "Our Bodies," pp. 70, 71. "Human Body, Elem Course." pp. 110-112.

Stomach digestion.

Movements of the stomach. Reading,—"How to Keep Well," p. 77. "Human Body, Elem. Course," p. 114.

Gastric juice.—Concerning qualities and composition read, "How to Keep Well," pp. 78, 79. "Our Bodies," p. 73. "Human Body, Elem. Course," p. 113.

Action of gastric juice.–Procure a small quantity of pepsin scales (Fairchild's) or make a glycerine solution of pepsin* from mucous membrane of a pig's stomach. One grain of pepsin scales is equivalent

*See Appendix.

to one table spoonful of the glycerine solution. Dilute one teaspoonful of hydrochloric acid in a pint of water. Procure fibrin* from blood. White of an egg hard boiled and finely cut, lean beef cooked and finely cut, and suet somewhat minced. Use test tubes or bottles.

a. Put one grain of pepsin scales into a test tube twothirds full of water. Place in this some shreds of fibrin. Make sure the liquid is *not* acid. *b.* Put shreds of fibrin into a test tube twothirds full of the dilute hydrochloric acid. *c.* Put one grain of pepsin scales into a test tube onehalf full of water. Add sufficient quantity of dilute hydrochloric acid to make distinctly acid. Put in shreds of fibrin—— Mark each test tube plainly. Keep for 24 hours in a place having about the same temperature as the body. (Great heat destroys and cold stops the digestive action.) Shake frequently. Observe all changes that take place. Infer the solubility of the fibrin at the end of the 24 hours. State the physical change produced on each of the substances. Infer the physical action of gastric juice on fibrin.

Repeat experiments *a*, *b*, *c* with the lean meat, with white of an egg, and with the suet. It would be well to repeat one set of experiments, keeping the test tubes in a cold place. Application of observed results can be made when considering the care of the organs. To show that starch is not affected by the gastric juice, put a teaspoonful of boiled starch in a test tube containing pepsin and hydrochloric acid in water.

Action of hydrochloric acid on mineral matter.—Procure some burnt bone and the leg bones of a turkey. *a.* Put some of the burnt bone (lime) into dilute hydrochloric acid. Observe all changes. *b.* Several days before the recitation put the leg bones of a turkey into dilute hydrochloric acid. Observe all changes. *c.* Apply to minerals in grains, well water, etc.——Infer the action of the hydrochloric acid of the gastric juice on some minerals.

Concerning these and other functions of the gastric juice read—"Our Bodies," p. 74. "Human Body, Elem. Course," p. 114. What is chyme? What does it contain?

Intestinal digestion.

Movements of the small intestine and the functions of the folds should be explained by the teacher.

Pancreatic juice.—Compare its qualities with those of the saliva.

Procure a small quantity of Fairchild's Extract of Pancreas or make a glycerine* solution of trypsin from the pancreas of a pig. One grain of pancreatic powder is equivalent to one tablespoonful of the

*See Appendix.

glycerine extract. Make also a watery* solution of trypsin from a pig's pancreas. Dilute one teaspoonful of hydrochloric acid in a pint of water. Get a little vinegar. Dissolve baking soda in half a pint of water Procure fibrin, skim milk, thick starch paste, a raw egg, and oil (olive). Have ready test tubes or bottles, a small saucer, a small pail or similar dish in which water may be kept hot, and some litmus paper.

Action on albumen,—fibrin. *a.* Put one grain of pancreatic powder into a test tube twothirds full of water. The liquid should be neutral when tested with litmus paper. Drop in shreds of fibrin. *b.* Put one grain of pancreatic powder into a test tube twothirds full of water. Make acid with dilute hydrochloric acid. Drop in shreds of fibrin. *c.* Put one grain of pancreatic powder into a test tube twothirds full of water. Add the solution of soda until the liquid is distinctly alkaline when tested with litmus paper. Drop in fibrin. —— Mark each test tube or bottle plainly. Keep for 24 hours in a place having about the same temperature as the body. (Great heat destroys and cold stops the digestive action. Shake frequently. Observe all changes. **Infer the solubility of fibrin at the end of 24 hours.**

Action on albumen of milk.—Test fresh milk with litmus paper. Skim off the cream (fat) Test sour milk with litmus paper. Observe in sour milk the liquid part (whey) and the solid part (curd). The curd contains casein and a little fat. Casein is albumen. *d.* Test vinegar with litmus paper. Dilute some skim-milk with half its bulk of water. Add by drops to skim-milk until the curd is precipitated. Observe all changes. *e.* Put in a test tube a tablespoonful of skim-milk. Dilute with half its bulk of water. Add half a grain of pancreatic powder. Shake well. Add by drops soda solution until the liquid is distinctly alkaline when tested with litmus paper. Shake well. Place the test tube or bottle into a dish of hot water (no hotter than can bear hand in) for an hour. Then add vinegar. Observe changes. If any compare with formation of curd. Infer action of pancreatic **powder on curd, casein of milk.**

Action on starch.—Place a tablespoonful of thick starch paste while yet warm in a little dish. Stir into it one grain of the pancreatic powder. Observe all changes. State that substance formed is sugar.

Action on fat.—*a.* Shake oil and water together. Observe all changes. *b.* Shake equal quantities of white of an egg and olive oil together. Observe all changes. What becomes of fat? What is this condition called? *c.* Put two grains of pancreatic powder into test

*See Appendix.

well. Observe all changes. What is produced? (The watery solution of pancreas may be used in place of the powder.)

State all the changes observed in these experiments. Read,—"Our Bodies," p. 75. "Human Body, Elem. Course," p. 117.

Bile.–Procure the gall bladder of an ox or pig with the bile yet in it. Reserve a little for experiments. Keep the rest in an air tight bottle.

What is bile? its color? taste? Test bile with litmus paper. Shake together bile and olive oil.

Reading.—"How to Keep Well," pp. 80, 81. "Our Bodies," p. 75. "Human Body, Elem. Course," p. 116.

Intestinal juice.–Reading,—"Our Bodies," p. 76.

Absorption. Observe the effect of keeping the hands in water for some time. What causes the effect? What food is absorbed from the mouth? by what? What is absorbed from the stomach? by what? into what vein does this blood flow? What is absorbed from the small intestine? by what? into what is each emptied? where?

Reading,—"Human Body and Its Health," pp. 100-110. Animal Physiology, Fothergill, pp. 48-55.

Review,—as indicated on page 42.

The Care of the Organs.

Foods. Review and amplify the points outlined on pp. 21, 22.

Reading,—"Our Bodies," pp. 51-56, 81 85. "Human Body and Its Health," pp. 77-88, 115, 116. "Human Body, Elem. Course," 81-90, 123-129.

Stimulants. Definition, kinds, effects of each.

Reading,—"Our Bodies," pp. 57-63, 88-90. "Human Body and Its Health," pp. 88-94, 116-118. "Human Body, Elem. Course," pp. 91-97, 130-132.

Care of the Teeth. Cleansing.–Why should the teeth be cleansed? What degree of stiffness should a brush have? why? What form? why? How should a brush be prepared for use? Where kept when not in use? why? What should be the temperature of the water used? why? What qualities should a harmless tooth powder have? What advantage in using a proper soap in cleansing the teeth? When should the teeth be cleaned with a brush? why? When should the powder or soap be used? why? What kind of a toothpick should be used? why? when? where? What is the benefit of using a silk thread for cleansing?

Filling.–Why should teeth be filled? when? How often should teeth be examined? why? What teeth should be filled?

THE MOUTH.

Function.	*Digested food.*	*Absorbed by.*	*Undigested food.*	*Passed to.*
Chewing breaks up food. mixes food with saliva. Saliva moistens, softens food. (alkaline) dissolves sugar ; salt and other minerals changes starch to sugar	Sugar in solution. Salt and other minerals in solution.	Veins of mouth, pharynx, esophagus absorb a small part.	Albuminous food, broken, moist'd, soft'd. Fatty food, (meats) broken, moist'd, soft'd. Starchy food, broken, moistened, softened. Sugar, undissolved. Salt, undissolved.	Pharynx, Esophagus. Stomach.

THE STOMACH.

Kneading mixes food with the gastric juice. Gastric juice changes and dissolves albumen. (acid) dissolves connective tissue and partly dissolves fibres of meat. dissolves albuminous walls of fat cells, setting fat free. dissolves minerals.	Sugar and minerals dissolved in mouth but yet not absorbed. Albuminous food in solution Minerals in solution.	Veins of the stomach. (to portal vein.)	Albuminous food, broken, moist'd, soft'd. Free fat. Starchy food, broken, moistened, softened. Minerals undissolved.	Small Intestine

THE SMALL INTESTINE.

Wormlike action mixes food with juices, moves the food onward, presses villi into food. Pancreatic juice moistens, softens food. (alkaline) changes and dissolves albumen. changes starch to sugar. dissolves sugar ; salts and other minerals. emulsifies fats. Bile moistens, softens food. (alkaline) emulsifies fats. aids in absorption. Intestinal juice—not well known.	Albuminous foods in solution. Sugar in solution. Salt and other minerals in solution. Emulsified fats.	Veins of the intestines. (to portal vein.) By the lacteals (to thoracic duct.)	Excess of a food. Indigestible parts. Minerals.	Large Intestine.

Removal.—Why should teeth be removed? when? What teeth should be removed? why? What is a "dead" tooth? What is an "ulcerated" tooth? Should a dead tooth be filled? When should an ulcerated tooth be drawn? why? Cite evils arising from the presence of "dead" teeth in the mouth. Is the crowning of teeth helpful or harmful?

Misuse.–Cite the common ways and effects of misusing the teeth.

Reading,—"How to Keep Well," p. 92. "Our Bodies," p. 87. "Human Body, Elem. Course," pp. 104, 105.

Care of the Stomach. Derive from previous points as much as possible.

Conditions for proper activity of the stomach. Effects of proper conditions. Hindrances to digestion. Effects of hindrances to digestion.

Reading,—"Human Body, Elem. Course," pp. 123-128.

Care of the Intestines. Conditions for proper activity, and their effects (diarrhoea, constipation).

Reading,—"Our Bodies," p. 86.

Subjects for discussion.

Name the tissue-forming foods, and heat-producing foods on the breakfast table.

Changes in food according to season and climate.

Cooking food.

Advantages of a varied diet.

Gum chewing.

Tea and coffee drinking.

Cider, beer, and ale drinking.

Whiskey, rum, and brandy drinking.

Effect of pure air on digestion.

Effect of the condition of the skin on digestion.

Effect of clothing on the amount of food needed.

THE CIRCULATORY SYSTEM.

The Blood.

Description. See p. 3.

Quantity. Reading,—"Our Bodies," p. 93.

Structure. Swing the arms briskly. Push a needle under the skin at the base of a finger nail. Observe the qualities of the blood which flows out. Put a very small drop on a glass slide* and place on the drop a cover glass*. Hold up to the light and observe the color. Examine with a powerful magnifying glass or with a microscope. Observe the color of the liquid (serum). Observe the form and appearance of the very numerous bodies (red corpuscles) in the liquid. What peculiar arrangement do these bodies assume? Observe the form and appearance of the few, scattered, irregular bodies in the liquid. Of what does plasma consist? Answer by thinking of the kinds of food absorbed and of wastes given off by the blood.

Coagulation. Collect a large drop of blood on a white plate. To prevent its drying breathe several times into a watch crystal or small plain tumbler and invert it over the blood. Observe at short intervals for five minutes. Remoisten the inside of the glass, again invert it, and observe several times during the next half hour. What is the outer part (serum)? its color? What is the inner (clot)? its color? Account for the color of serum? of clot?

Collect in a fruit jar freshly drawn blood, and stir vigorously with a bundle of twigs for several minutes. Wash the mass (fibrine) on the twigs till it becomes white, and observe all the qualities of fibrine. Cover the jar air tight, and observe if a clot forms. What is the liquid? Account for its color. Of what does the clot in blood consist?

When does blood coagulate in the body? Of what value is coagulation?

Reading.—"How to Keep Well," pp. 97-99. "Human Body and Its Health," pp. 52-55. "Our Bodies," pp. 92-95, 259. "Human Body, Elem. Course," pp. 134-138.

The Organs.

Heart. Specimens,—*a*, harslet with heart and heart case uncut; *b*, internal organs with unbroken connections from a smaller animal; *c*, calf's or sheep's heart for study of cavities; *d*, calf's or sheep's heart for study of valves.

*A glass slide 3 inches by 1 inch can be cut from window glass.

A cover glass is a very thin piece of glass used to protect the object on the slide. It can be obtained of a physician who uses a microscope.

What is the heart case? (specimen *a*.) Cut a slit in the lower end and collect in a bottle the liquid (serum) which flows out. Keep it in an air tight bottle. Observe the qualities of the liquid and infer its use. Slip back the heart case and observe where it is attached.

Push a finger or closed glass rod through one of the openings into the heart. What is the heart? its form? comparative size?

Where in the chest is the heart? How is it placed? (Inflate the lungs of specimen *b*. See diagrams.) Between what ribs can you feel the beat? How is the heart held in place? Find in *a* membranes extending from the heart case to the diaphragm.

Cut off an inch or more of the apex of *c*. Put a finger into each of the cavities of the apex; then try to make them touch each other; feel and see the thickness of these cavities (ventricles). Find on the base of the heart two small dark-colored parts having coarsely notched edges; put fingers or glass rods through the openings in the base into these cavities; try to make these fingers touch each other; feel and see the thickness of the walls of these cavities (auricles). How is the heart divided? what cavities in each side? Compare the thickness of the walls of the ventricles. Replace the apex cut off. Find on the outside lines of the fat extending from the base obliquely toward the apex. Of what do these mark the position? Which ventricle extends the farther into the apex? Hold the heart in position corresponding to that in the body. Which ventricle and auricle are on the left side? on the right side?

Find in specimens *a* and *c* tubes connected with the heart at its base. Which are arteries? which veins? Into what do the veins enter? Push closed glass rods through the veins into the auricles. How many veins enter the right auricle? from what? How many veins enter the left auricle? from what? From what do the arteries extend? Push rods through the openings in the apex of *c* into the arteries. How many arteries extend from each ventricle? to what? Find opening between auricle and ventricle.

Cut the heart case from *d*; cut the auricles from the ventricles along their front edges. Fold back the auricles so as to expose the openings into the ventricles. Find membranes attached to the ventricles. Where is the base of each membrane? By what are the sides of each attached? to what? How many valves between right auricle and right ventricle? between left auricle and left ventricle? —— Slit open the arteries to the edge of the ventricles. What closes the openings to the ventricles? What is the form of each part? To what is each attached? How many at the beginning of each artery?

Reading,—"Our Bodies," pp. 95-98. "Human Body and Its Health," pp. 61-64. "Human Body, Elem. Course," pp. 139-142.

Arteries. Review work indicated on p. 10. Study *a*, *b*.

Describe an artery. What is the relative position of the large arteries of the trunk? of the extremities? How are arteries held in place? How do arteries differ from veins? Find branches of the aorta in *b* and to what each extends. Slit open the aorta along its rear border and push a knitting needle into various openings. Open the pulmonary artery and trace its branches. Study a diagram of the distribution of the arteries.

Reading,—"Our Bodies," pp. 97-99.

Capillaries. Specimens,—capillaries on the face, on the inside of a frog's skin, on a shin of beef. "Our Bodies," p. 251.

Reading,—"Our Bodies," p. 101, 102. "Human Body, Elem. Course," pp. 146-147.

Veins. Review work indicated on p. 10. Study *a* and *b*.

Describe a vein. What is the relative position of the large veins of the trunk? of the extremities? How are veins held in place? Find valves in veins. (See p. 10.) Find branches of veins entering the heart. From what organs do the branches extend to the main veins? Study a diagram of the distribution of the veins.

Reading,—"Our Bodies," p. 100. "Human Body and Its Health," pp. 68-70.

The Functions of the Organs.

Action of the Heart. Specimens,—*c* and *d* as indicated on p.

The beat.—Hold *d* by the arteries and raised auricles, encircle the apex with the other hand. Have a second person pour water into the ventricles till the valves float up into position, then squeeze the apex to represent its contraction, and observe the effect on the valves. —— Fit a cork to the large branch of the aorta and bind tightly; fill the aorta with water. Why does it remain full? Push a glass rod into the aorta. Try the same with the pulmonary artery. Infer the order in which the cavities are filled and the parts contract.

Reading,—"Human Body and Its Health," pp. 64-67. "Human Body, Elem. Course," pp. 141, 142. ("Human Body, Briefer Course," pp. 216-219, to be simplified and stated by the teacher.)

Sounds of the heart.—Borrow a stethoscope and listen to the beating of your own and then of another's heart.

Reading,—"Our Bodies," p. 104. "Human Body and Its Health," p. 67.

Work of the heart.—Reading,—"Our Bodies," p. 97.

Action of the arteries. Repeat experiments, ¶ 4 and 5, p. 10.

Apparatus.—Push the metal nozzle of a common rubber syringe into the end of a long rubber tube and bind very tightly. Have a glass tube drawn to a capillary opening, dishes, and water at hand.

Show the valves of the bulb and lead pupils to see the correspondence of the various parts with those of the heart and arteries.

Feel the changes in the tube, see the direction and kind of flow when opening is (*a*) full size, (*b*) partly closed. (Teacher forces the water regularly.) State what is observed in case *a;* case *b;* and causes. Tube wide open corresponds to an artery severed near the heart, and partly closed to a smaller part of the artery severed in a limb. In which direction through an artery does blood flow? What is done to an artery by the jet of blood passing through it? What is this called? Where can this be felt?

Count the number of pulse beats per minute when reclining, standing, walking, after running; in a boy or girl, in a young man or woman, in an old person.

Reading,—"Our Bodies," p. 105. "Human Body and Its Health," pp. 71, 72. "Human Body, Elem. Course," p. 145.

Action of the capillaries. Illustrate the kind of flow by putting glass tube with capillary opening into rubber tube and forcing water through.

Reading,—"Our Bodies, pp. 101, 102. "Human Body, Elem. Course," pp. 147.

(Blood plasma, containing nourishment and oxygen passes out through the walls of the capillaries to the tissues and at the same time the blood loses its bright red color. A watery liquid, containing solid wastes and carbonic acid gas passes back into the capillaries. The quantity of plasma which oozes out from the capillaries is greater than the quantity of liquid which oozes back into the capillaries.)

Action of the veins. Repeat experiments, ¶ 4 and 5, p. 10. In what direction does blood flow through the veins? What prevent a backward flow? What kind of a flow is there from a severed vein?

Reading,—"Our Bodies," p. 101.

Circulation of the blood.

Necessity of a circulation.—What must be introduced? removed from the body?

Systemic circulation.—Trace the blood from the left ventricle to all parts of the body back to the right auricle. What is the "portal circulation"? What is the color of the blood in the systemic arteries? in the systemic veins?

Pulmonic circulation.—Trace the blood from the right auricle to the

left ventricle. What is the color of the blood in the pulmonic arteries? in the pulmonic veins?

Rapidity of circulation. Reading,—"Our Bodies," pp. 95, 96, 103. "Human Body, Elem. Course," pp. 144, 145. Animal Physiology, Fothergill, pp. 56-66.

The Care of the Organs.

Variations in the circulation. What variation is there in the blood supply to the digestive organs? when? why? What variation in the blood supply of the brain? when? why? What variation in the blood supply of the muscles? when? why? What do these variations teach us concerning the care of the body?

What is a blush? to what due? What is paleness? to what due? where is the blood? What is fainting? to what due? How can you recover a person who has fainted? Give your reasons for each step. If necessary, how could two persons easily remove one who has fainted from a crowded hall?

Why does an injured portion of the body become red, swollen, hot, and painful?

Temperature. Find the temperature of the body by placing the bulb of a small thermometer in the mouth. What is the average temperature of the body when in health? Name common ways in which the temperature of the body is lessened. What is the effect on the circulation of the blood? What organs are peculiarly liable to feel the effects? What are the names of some of the resulting diseases?

How should colds be treated? Give reasons. If you became accidentally wet to the skin what could you do to prevent chilliness while going home or to a place of shelter? after reaching home?

Name common ways in which the temperature of the body is increased to the average; beyond healthful degree. How does the action of the skin affect temperature? How can the temperature be safely lessened to the usual degree? Cite common simple cases.

Compression. Recall the position of the arteries. Recall the position of the deep seated veins, of the surface veins especially of the extremities. What are the effects of compressing the waist on the blood supply? on organs below the waist? on organs above the waist? on the mind? What are the effects of wearing tight collars and neck-bands? What are the effects of tight bands on the arms? on the legs? How should clothing be worn?

Exercise. What are the beneficial effects of exercise on the circulation? Cite cases. Show that the beneficial effects depend on the quantity and time of taking exercise.

Reading.—"How to Keep Well," pp. 108, 109. "Human Body, Elem. Course," pp. 153-158.

Cuts, bruises, bleeding. Call a pupil before the class. State the part of the body injured, the kind and degree of injury. Teach what to do in each case and the reasons. Have pupils practice on each other till considerable facility is acquired, and then have the processes accurately stated. Examine the class by having different pupils demonstrate (that is operate and explain at the same time) the method of treatment. Have necessary materials at hand.

1. A finger is gashed while whittling. *2.* The ball of the thumb is cut by a piece of glass; not much bleeding. *3.* The palm of the hand is cut by a knife; due to fall in the street. *4.* Skin is rubbed from palms and wrists by severe fall on brick sidewalk or concrete. *5.* Back of hand deeply scratched by rusty nail. *6.* Finger partly chopped off by an axe. *7.* Forearm cut by sickle; profuse bleeding, no spurts. *8.* Forearm deeply cut by scythe; profuse bleeding by spurts. *9.* Forearm cut by falling slate; very profuse bleeding. *10.* Wounded person shows a tendency to faint.

Teach pupils how to assist a person who is weak from loss of blood to walk; how to carry a person unable to walk but able to be carried in a sitting position.

Reading.—"Our Bodies," pp. 215-219. "Human Body, Elem. Course," pp. 158-160.

Alcohol. Cite known cases if possible.

How alcohol gets into the blood.

Effects of alcohol on the blood; circulation; heat; arteries; capillaries; veins.

Reading.—"How to Keep Well," pp. 109, 110. "Our Bodies," pp. 105-107. "Human Body, Elem. Course," pp. 161, 162.

The Lymph.

Specimen.—the liquid which flows from a blister or collects in a healing wound.

Through the walls of the finest capillary bloodvessels in all parts of the body there passes from the blood a liquid, transparent, colorless, and containing nourishment. The liquid gives up most of its nourishment for the growth and repair of the tissues and takes up the wastes.

This liquid transparent, colorless, containing nourishment and waste is the lymph.

Some of the lymph soaks back into the blood capillaries and is thus removed. The excess is collected in capillary tubes called lymphatics which are like blood capillaries though much thinner.

They gradually unite into larger tubes.

The lymphatics of the right side of the head, neck, and chest, and of the right arm form the right lymphatic duct which empties into a vein under the right collar bone. The lymphatics draining the rest of the body unite to form the largest lymphatic tube of the body, the thoracic duct. It is about the size of a goose quill and is attached along the spinal column from the small of the back to the left collar bone under which it empties into a vein extending to the heart.

Reading,—"Our Bodies," p. 79. "Human Body and Its Health," pp. 112-114. ("Human Body, Briefer Course," pp. 186-189.)

THE RESPIRATORY SYSTEM.

The Organs.

Nose. Review work indicated on p. 16, Nostrils.

Notice carefully the many curved passages for the flow of air.

Pharynx. Review work indicated on p. 14, Pharynx.

Larynx. Specimens,—human body, harslet of a calf or sheep including the larynx. (Special direction must be given that the larynx be not cut from the trachea.)

Review work indicated on p. 17.

Feel of the front part of the larynx in the neck. Feel the sides, top, bottom. Examine the larynx of a calf or sheep. What is it? its shape? of what made?

Where is the larynx? How is it supported? What motion has it? What prevents food from entering the larynx? how?

Hold the larynx of calf up to the light and look through the opening. Observe the narrowest part. What causes the narrowing? Which way does the opening extend?

Reading,—"Our Bodies," pp. 199-203. "Human Body, Elem. Course," p. 168.

Trachea. Specimens,—See Larynx.

Review work indicated on p. 17.

What is it? its color? size? Where is it? How is it supported?

Of what does the trachea consist? Where does the trachea divide? What are the divisions called?

Reading,—"Our Bodies," p. 110. "Human Body and Its Health," p. 130.

Lungs. Specimens,—See Larynx.

Review work indicated on p. 17.

Describe the lungs telling their prominent qualities. Which has the more lobes? What is the benefit of lobes?

Where is the right lung? the left lung? What are between the lungs? Find the root of the lung? Why is it so called? How are the lungs supported?

With what is the lung covered? What lines the inside of the chest? (Observe on the inside of ribs in a side of beef or mutton in the market.)

What bloodvessels enter the lungs? leave the lungs? What other vessels in the lungs? What is the relative position of the capillary bloodvessels and air tubes?

Reading,—"How to Keep Well," pp. 113-116. "Our Bodies," pp. 110-113. "Human Body and Its Health," pp. 123-127.

Diaphragm. Review work indicated on p. 18.

The Functions of the Organs.

Why air is needed. Review work indicated on p. 22.

Why we breathe. Review work indicated on p. 23.

Nose. What is done to the air while passing through the nose? How do you know it? Of what advantage are the many curved passages? How is the mucous membrane kept moist? What are the uses of the hairs within the nose?

Larynx. Stretch over the end of a cylindrical chimney two pieces of very thin sheet rubber, leaving a narrow slit between them. Hold or bind tightly and teen blow through the tube from the other end. Observe the pitch of the tone. Widen, then narrow, the slit a very little, the tension remaining the same. Observe all changes in pitch. Lessen and increase the tension, the slit remaining the same. Observe all changes in pitch.

Infer the action of the vocal membranes. State how tones of high, medium, and low pitch are produced. Find by experiment how changes in force, length, and quality of tone are produced.

Trachea. What is the use of trachea? What is the use of the rings? How is the lining of the trachea kept moist? Of what advantage is the moisture?

Lungs.

Enlargement of the chest and flow of air.

Home work.—If convenient remove all the clothing except the underwear. *Do not hold the breath in any experiment unless so directed.*

1. Stand easily erect. Trace the ribs from back to front. What is

their position? Place your hands lightly on your breast and raise your chest as much as possible. Trace the new position of the ribs. What changes did you feel? Lower your chest as much as possible. Trace the position of the ribs now. What changes did you feel? *2.* Place the fingers on the breast bone, glance downward. Raise your chest high, then lower it. What changes did you feel and see? *3.* Place your hands lightly on the sides of the chest. Raise your chest, lower it. What changes did you feel and see? *4.* Place a tape measure around the chest about on a level with the sixth rib. Lower your chest and note the girth. Raise your chest to the highest point and then note the girth. How much did you increase the girth?

What enabled you to move the chest in these ways? Which way does the air flow when you raise the chest? when you lower the chest?

Recall the appearance and position of the diaphragm. *5.* Place the hands on the abdomen, glance downward. Inhale as usual. What changes did you feel and see? Infer the motion of the organs of the abdomen. Infer the action of the diaphragm. Which of these motions is the cause of the others? *6.* Place the hands on the abdomen, glance downward. After inhaling as usual exhale forcibly. What changes did you feel and see? Infer the motion of the abdominal organs. Infer the action of the diaphragm. Which motion is the cause of the others?

Which of these motions occur when the chest is raised? when lowered?

School work.—(Ascertain the results of the home work, repeat the experiments if necessary. Call a pupil before the class, direct him to loosen his coat, and then lower his chest as much as possible. Then place one foot of the calipers* on his breast bone, the other on his spinal column, and note the angle on the quadrant. Direct the pupil to raise his chest to the fullest degree. Note the new angle. Place the ends of the calipers on the board and reproducing the angles mark the two distances which are the depths of the chest.

In a similar way place the ends of the calipers on the sides of the chest and measure its width. Measure the depths and widths of the abdomen.)

In what direction can the chest be enlarged? What muscular action is necessary to enlarge the chest transversely? longitudinally? What is the direction of the flow of air when chest capacity is being increased? when being diminished? What is each flow called? What are both together called? Upon what does the degree to whichthe lungs can be inflated depend?

*See Appendix.

Reading,—"How to Keep Well," p. 117. "Our Bodies," pp. 113-115. "Human Body and Its Health," pp. 130-133. "Human Body, Elem. Course," pp. 171-174.

Changes in the air in the lungs.

1. Lower a small piece of burning candle into a fruit jar. Through a glass tube reaching to the bottom of the jar breathe slowly and steadily. Observe the effect on the flame. (The teacher should state that the effect is due to the presence of carbonic acid gas in the expired air.) State the different effects of ordinary air and expired air on combustion. What change takes place in the air in the lungs?

2. Breathe on a dry pane of cold glass. Observe the condition of the glass immediately after breathing upon it. Compare the amounts of moisture in equal quantities of ordinary and expired air. Name a second change made in the air in the lungs.

3. Pass from the pure air into a poorly ventilated room occupied by a company of people. Smell the odor. (The teacher should state that the odor is due to the animal matter exhaled.) State a third change in the air in the lungs.

4. Note the temperature indicated by the mercury in a thermometer. Breathe upon the bulb. Observe the effect. State a fourth change in air in the lungs.

Reading,—"How to Keep Well," pp. 118-120. "Our Bodies," pp. 115, 116. "Human Body and Its Health," pp. 135-137.

Changes in the blood in the lungs.

What does the air lose in the lungs? to what? What does the air gain in the lungs? from what? State the different changes in the blood in the lungs.

Reading,—"Human Body and Its Health," p. 134. "Human Body, Elem. Course," pp. 164-166.

Rapidity of respiration.

Get some one to count your respirations per minute when you are asleep, sitting, walking, after running. Count the respirations per minute of a boy, of a girl, of a young man, of a young woman, of an old man, of an old woman. Why does one respire oftener when exercising? What is meant by getting the "second wind" when running?

Reading,—Animal Physiology, Fothergill, pp. 66-74.

The Care of the Organs.

Nostrils. What is their importance in respiration? What are the bad effects of breathing through the mouth? How can one learn to breathe through the nostrils even when taking violent exercise? What

is a "cold in the head"? its causes? its effects? What is catarrh? its causes? its effects?

Reading,—"Human Body, Elem. Course," p. 184.

Throat. What is the effect on the throat of compression by tight collars, neckbands, or mufflers? Give reasons. What are the dangers arising from overprotection? What is a sore throat? its causes?

Reading,—"Our Bodies," p. 200.

Larynx. What are the effects of loud talking, shouting, or continual use of the voice? What are needed that the larynx may do much and good work easily? What is hoarseness? its causes? Give reasons why the voice should usually have moderate force, medium pitch, and pleasant quality? What is meant by the change of voice? What especial care is necessary at that time?

Reading,—"Human Body and Its Health," p. 139.

Lungs. What the is necessity for deep breathing? For whom is it necessary? What does gaping or yawning signify? Watch a boy or girl breathe while asleep. Which is the more active the chest or abdomen? Why do boys and girls dislike to wear tight clothing? What are the effects of wearing a coat or dress that buttons tight across the chest on the chest muscles? on the position and movements of the ribs? on the chest capacity? on the lung capacity? on the appearance of the person? What are the effects of tight clothing around the waist, of close fitting stiff clothing around the abdomen, of supporting the clothing from the waist on the muscles of the abdomen? on the positions and motions of the abdominal organs? on the position and motions of the diaphragm? on the position and movements of the ribs? on the chest capacity? on the lung capacity? on the tendency to disease or weakness of the lungs? on the general strength of the body?

Reading,—"Human Body, Elem. Course," pp. 182, 183.

Pure and impure air. Review, p. 24.

Reading,—"Our Bodies," pp. 117, 118.

Effects of breathing pure air, impure air. Review, p. 24. Amplify with many illustrations from experience and observation.

Reading,—"Human Body and Its Health," pp. 176-179.

Ventilation. Review, p. 24. Amplify in a practical manner. Impress the dangers of poor ventilation.

Reading,—"Human Body, Elem. Course," pp. 180, 181. Anatomy, Physiology, Hygiene, Calvin Cutter. A, P, H, Walker. Women, Plumbers, and Doctors, Plunkett. Principles of Hygiene, Hunt.)

Drainage. Review, p. 24. Amplify by personal investigation. Pupils should be so impressed with the great dangers arising from bad drainage that they will be observant of home conditions and eager to remedy them when found harmful.

Reading,—See Ventilation.

Alcohol. Cite known cases if possible.

Effects of alcohol on the mouth and pharynx; on the larynx, trachea, and lungs.

Reading,—"Our Bodies," p. 122. "Human Body, Elem. Course," p. 184. (Principles of Hygiene, Hunt.)

Tobacco. Cite many known cases.

Effects of tobacco on mouth, and pharynx; on the larynx, trachea, and lungs.

THE SECRETORY SYSTEM.

Gland. Review work indicated on p. 30.

Membranes. How are the mucous and serous membranes kept moist? Compare their functions with functions of glands.

Secretion, Excretion. Fill out these lists as fully as you know.

Organ	separates from blood	ducts	pour into	use.

Which of the substances separated from the blood are liquids? gases? What is a fluid? Which of the fluids separated from the blood are for use in other parts of the body? What are they named? Which fluids separated from the blood are to be removed from the body? What are they named? Define a secretion; an excretion.

The Secretory Organs.

Fill out these lists. Consider (*1*) membranes, (*2*) glands.

Organ	Secretion	Ducts	Poured into	Functions.

Synovial membrane may be considered in detail when joints are studied, oil glands in connection with the skin, tear glands in connection with the eyes, wax glands in connection with the ears.

THE EXCRETORY SYSTEM.

Excretion. Review.

Lungs. Review structure and function. What wastes do the lungs separate from the blood? How are they removed from the body?

Perspiratory glands. A simple model of a perspiratory gland can be made as follows. Procure one half yard of covered bonnet wire. Coil twelve inches of it into a compact spherical mass at the same time intertwining it with a red string. Twist three inchs of the free end into a spiral. The covering, held open by the wire, represents the tube; the coiled mass the gland; the free portion the duct; the red string the capillary bloodvessel.

Study the models. Read diagrams and text,—"How to Keep Well," pp. 129-132. "Our Bodies," pp. 131-133. "Human Body and Its Health," pp. 157-159, 162-164. "Human Body, Elem. Course," pp. 66, 67,

Describe a perspiratory gland. Where is the gland? Through what does the duct extend? What is the opening of the duct called? Where are the glands most numerous? How do you know? What is the function of each gland?

What is perspiration or sweat? When is it called sensible perspiration? insensible perspiration? How much is excreted in a day? How does the perspiration affect the temperature of the body? Why is frequent bathing necessary?

Kidneys. Specimens,—*a*, human body; *b*, sheep's kidney and its vessels free of fat; *c*, sheep's kidney and its vessels in the fat; (Ask the marketman to cut the fat enclosing the kidney close to the backbone, and 3 or 4 inches below the kidney in order to show the artery, vein, and ureter in their natural positions.) *d*, kidneys with connected internal organs from a small animal.

To remove fat from the kidney and its vessels.—Find part of the vena cava ascending on the fat which was next the backbone. If a portion of the liver is present the vena cava will probably be attached to it. Find an opening from the vena cava and trace it with a large blunt steel knitting needle. Find a portion of the abdominal aorta beside the vena cava. Find an opening from the artery and trace it with another needle. Cut the fat square across the end below the kidney. Find near the edge of the fat the end of a fine tube, the ureter. Trace this with a fine blunt needle. Use the needles as directors and cut and tear the fat from the kidney and its vessels.

Specimen *b*. What is the color of the kidney? its shape? Find the notch. What tubes enter the kidney? where? Draw an outline of the kidney and the vessels entering it. Study diagrams,—"Human Body and Its Health," p. 58. "Human Body, Elem. Course," p, 186.

Where in the abdomen are the kidneys? What organs touch them? How are they held in place? Study specimens *c* and *d*, and diagrams.

Which edges of the kidney are next the spinal column? Place the palms of your hands on the small of your back, finger tips just touching the hip bones. They are over the kidneys. (The kidneys extend from eleventh ribs nearly to hip bones.)

(Find with the class in specimen *c* the bloodvessels and ureter as directed above and then remove all the fat. Place the kidney on its side, cut along the outer curve separating the kidney into two parts like the parts of a bean. Do not cut any of the vessels in the notch.)

Of how many parts is the kidney composed? What is the color of the outer part? Push the needles through the bloodvessels until the ends show in the kidney. Infer in which part of the kidneys the blood capillaries are. What is the color of the inner part. (Teacher explains that the fine lines are minute tubes which begin in the outer part and extend to the notch.) Push a needle through the ureter till the end appears.

(The function of the kidney should be explained by the teacher. Blood flows through the artery to the capillaries in the outer part of the kidney. Waste matter called urine soaks out of the capillaries and is conveyed by fine tubes to the ureters which carry it to the bladder. The blood having given up the poisonous urine flows from the capillaries through the veins toward the heart.)

Bladder. The teacher should state what it is, where it is, consider chiefly its function and care. Impress upon children the need of frequently emptying the organ.

Reading,—"Our Bodies," pp. 194-196. "Human Body, Elem. Course," pp. 185-188. Science Primer, Physiology, Foster, § VII.

Alcohol. Reading,—"Our Bodies," p. 197. "Human Body, Elem. Course," p. 189.

THE OSSEOUS SYSTEM.

The Organs.

Bones. Specimens,—*a*, human body; *b*, skeleton, mounted if possible; *c*, shoulder blade, arm bone, shin bone, knee bones of an ox, each bone dry and clean, and cut through lengthwise and crosswise, or the corresponding bones of a hind leg, similarly prepared; *d*, fresh shoulder blade and arm bone of an ox, each bone being cut lengthwise and crosswise; *e*, gristle in raw meat, bones from veal, lamb, or other young animal; *f*, leg bones of a fowl, weak hydrochloric acid in a fruit jar; *g*, burnt bone.

Feel the bones in your arms, hands, legs, feet, chest, and head. Where can you feel the bones most plainly? why?

Reading,—"How to Keep Well," p. 13. "Our Bodies," p. 11. "Human Body, Elem. Course," p. 12.

Count the bones of your upper arm, forearm, palm of hand, fingers. Count the bones in the corresponding parts at the legs. Count your shoulder blades, collar bones, hip bones, and ribs. Observe bones (vertebrae) of the spinal column; count the vertebrae in a picture of the human skeleton. Find in the picture to what the ribs are attached behind, in front. Find how many and which ribs are attached separately to the breastbone, how many and which ribs are attached to each other and then to the breastbone, how many and which ribs are not attached to the breastbone.

Specimens,—*a*, *b*, and *c*. Find four kinds of bones according to form. Describe each. What is the form of the bones of the arms and legs? of the wrists and ankles? of the shoulder blades, hips, and of the skull except the face? of the bones of the face, of the vertebrae?

Reading,—"How to Keep Well," p. 17, 21-23. "Our Bodies," pp. 20, 22. "Human Body, Elem. Course," pp. 16, 18.

Specimen *c*. Find three kinds of projections on bones. Name each. Find three kinds of depressions in bones. Name each.

Reading,—"Our Bodies," pp. 19, 20.

Specimens *c* and *d*. Find two kinds of tissue in each bone. Name each. Observe the distribution of each kind of tissue in a long bone. Draw diagrams of transverse sections through the shaft and end of a long bone. Observe and describe the distribution of the two kinds of tissue in a short bone; a flat bone. Find the cavities of the various bones. What fills each? Which are called marrow bones? why?

Reading,—"How to Keep Well," pp. 15, 16. "Our Bodies," p. 13. "Human Body and Its Health," pp. 28, 29. "Human Body, Elem. Course," p. 24.

Specimen *d*. (Wrap the fresh bones if somewhat dry in a wet towel.) Find a part of a long bone on which there is no muscle. Peel the membrane from the bone. Remove the muscle and peel off the membrane. Remove the marrow from a long bone cut lengthwise and examine the inside surface of the shaft. How much of each bone is thus covered and lined? (invested.) Of what is the membrane made? What does it contain? Describe the membrane. (periosteum.)

Reading,—"Our Bodies," p. 13. "Human Body, Elem. Course," p. 26.

Specimens *d* and *e*. Observe and describe the qualities of gristle (cartilage) seen in raw meat. Try to cut bones of young veal or lamb.

Try to cut corresponding bones of adult animals. Compare bones of young and old animals. Compare the tracheas of young and old animals. Compare the cartilage on the ends of bones from young and old animals. Distinguish between temporary and permanent cartilage.

Reading,—"Human Body, Elem. Course," p. 13.

Immerse the leg bone of a fowl in dilute hydrochloric acid (several days before the class exercise). Observe changes in appearance and qualities. What substance remains? Infer what has been done to the bone.

Burn a bone. Observe changes in appearance and qualities. What substance remains? Infer what has been done to the bone. Of what does bone consist?

Reading,—"How to Keep Well," pp. 14, 15. "Our Bodies," p. 12. "Human Body and Its Health," p. 30. "Human Body," Elem. Course," p. 27.

Joints. Specimens,—*a*, human body; *b*, skull of an animal; *c*, part of backbone of an ox, spines and parts of ribs yet attached, muscle nearly all removed; vertebrae of an animal; *d*, hip and shoulder joint from mutton, fowl, or beef; knee or elbow joint from mutton or fowl; ankle or wrist joint from beef shank or shin; fresh and cleaned specimens of each.

Study specimens as indicated on p. 12.

Ligaments. Specimens,—fresh specimens of *d* under *Bones*.

Study specimens as indicated on p. 12.

Reading,—"How to Keep Well," pp. 19, 29-32. "Our Bodies," pp. 18, 30-32. "Human Body and Its Health," pp. 31-32. "Human Body, Elem. Course," pp. 18, 36-38.

The Functions of the Organs.

What is the relation of the skeleton to the other parts of the body? What advantages are secured by hollow shaft? lattice work? enlarged ends? rough surfaces? What is the especial function of each of the following organs? How does the structure ensure the function in each case? Skull, spinal column, ribs, pelvis, upper extremities, lower extremities, joints, synovia, cartilage, ligaments, periosteum.

Reading,—"How to Keep Well," pp. 19-32. "Our Bodies," pp. 16, 21, 30. "Human Body and Its Health," pp. 19-28. "Animal Physiology," pp. 28-34. "Human Body, Elem. Course," pp. 14-20, 26, 28-30. A. P. H., Tracy, pp. 11-14, 19-24.

The Care of the Organs.

Food. The food should contain sufficient bone forming material. Why? Name such foods.

Exercise. The exercise in kind and amount should be adapted to the age, health, and development of the bones of the individual.

Position. Standing and sitting positions should be such as to preserve the good form of the body. Name the points of a proper standing position, of a proper sitting position. How can each be secured?

Deformities. Inclined head, round shoulders, narrow chest, wasp-like waist, curvatures of the spine, curvature of thigh bone, bow legs, deformed feet. What causes each? How can each be cured? Duties of parents and teachers.

Fractures, sprains, dislocations.

Reading.—"How to Keep Well," pp. 32-34. "Our Bodies," pp. 22, 33. "Human Body, Elem. Course," pp. 30-34. A. P. H., Tracy, pp. 25-28.

THE MUSCULAR SYSTEM.

The Organs.

Muscles. Specimens,—*a*, human body; *b*, frog from which skin has been removed; *c*, shin or shank of beef; *d*, side of beef or mutton in the market; *e*, cooked corn beef.

Feel of the middle and ends of the muscle on the front side of the arm when the arm is bent. When sitting feel of the muscle on the under side of the thigh, then of the ends of the muscles next the knee. Examine muscle in *b* and *c*. What parts has a muscle? Describe each.

Feel the shape of the muscle on the front side of the upper arm while the arm is hanging by the side, also when the hand is clenched and the arm is bent. Separate with the fingers the muscles on a frog's thigh; draw and describe their shape. Find muscles on the chest extending from the breast bone to the arms; draw and describe their shape. Find other muscles on the chest and the legs having a different shape. Find on *d* muscles having a different shape; draw and describe their shape. Study the picture of the muscles around the mouth; draw and describe the shape. Name the four common shapes of muscles. Draw a diagram of each indicating the direction of the fibres and the position of the tendon.

To what are muscles attached? how? Study *a*, *b*, *c*. Review Tendons, p. 9.

Raise the muscles one at a time on the trunk of a frog and remove carefully ; also on the legs. How are the muscles arranged about the skeleton? Bend and extend your arm, at the same time feeling how the muscles are attached to the bones at the elbow. Find in *b* and *c* how the muscles around joints are attached. Pick apart the muscle of *c* and *a*. Make a cut crosswise through the muscle of *c*. Draw a diagram of this section. Trace the fibres of the tendon through the belly of the muscle in *c*.

Reading,—"How to Keep Well," pp. 36-38, 42, 43. "Our Bodies," pp. 36-40.

The Functions of the Organs.

Action of a muscle. Feel the changes in the front muscle of your upper arm as you bend and extend the arm at the elbow. Describe changes perceived. What can a muscle do? What does the tendon do?

Reading,—"How to Keep Well," pp. 39, 40. "Our Bodies," p. 38. "Human Body, Elem. Course," p. 41.

General functions. What is the common function of all muscles? What is the function of the arm? hand? leg? foot? How do we stand? walk? run? What functions common to all muscles on the outside of the skeleton.

Reading,—"Our Bodies," p. 43. "Human Body, Elem. Course," pp. 39, 44-46.

Voluntary muscles. How are the voluntary muscles controlled? What are the chief functions of voluntary muscles? Describe the action of the muscles of the jaw, of the upper arm, of the forearm and hand, of the chest and abdomen.

Involuntary muscles. How are the involuntary muscles controlled? What is their chief function? Describe the action of the esophagus, of the stomach, of the heart.

Reading,—"How to Keep Well," pp. 41. "Our Bodies," p. 38, 39. "Human Body, Elem. Course," p. 42, 43.

Functions of tendons. Experiment with the tendons in a chicken or turkey leg.

Reading,—"How to Keep Well," pp. 42-44. "Our Bodies," pp. 40, 41.

Review. Reading,—Science Primer, Physiology, Foster, pp. 21-40. Animal Physiology, Fothergill, pp. 34-47.

The Care of the Organs.

Blood supply. The supply of pure blood should be always abundant. The abundance of the supply depends on the freedom of the blood-vessels from compression and on judicious exercise.

Exercise. Review, p. 27.

Rest. Review p. 27.

Training is holding the mind and body to right activity till correct habits are formed. Why is training necessary? Find reasons for the following principles :—All the muscles should be exercised. Exercise should be regular and frequent. Exercise should be light and long continued rather than violent and spasmodic. The action should be increased slowly both in speed and force. Cessation from severe exercise should be gradual. The exercise should be adapted to the needs of the individual. Much attention should be given to the diet. The mental state affects the value of the exercise.

Reading,—"Human Body and Its Health," pp. 44-48. "Human Body, Elem. Course," pp. 50-57. "Essentials of A. P. H.," pp. 37-41. A. P. H., Calvin Cutter, pp. 89-98.

Alcohol. Cite known cases. Review, pp. 19, 20.

Reading,—"How to Keep Well," p. 49. "Our Bodies," p. 48. "Human Body, Elem. Course," p. 58.

THE NERVOUS SYSTEM.

The Organs.

Forms of Nerve Matter. Review Nerves, p. 11.

Divisions of the Nervous System. Specimens,—See p. 11. Diagrams,—"Our Bodies," pp. 41, 42. "Essentials of A. P. H.," pp. 165, 175. A. P. H., Calvin Cutter, pp. 211, 223, 224.

Find the centers which are connected and the nerves branching from each. Group the centers and nerves according to their connection. What does the *cerebro-spinal* system include? What does the *sympathetic* system include? Draw a diagram of each system.

Reading,—"Our Bodies," pp. 142, 143. "Human Body, Elem. Course," p. 193.

Brain. Specimens,—Sheep's or calf's brain enclosed in its membranes, and the skull from which the brain was removed. The outside membrane may be found adhering to portions of the skull.

What covers the brain, lines the skull? What is its color? Try to tear it. Of what is it made? Cut this membrane (dura mater) and find into what it sends processes.

Find a membrane on the brain. Observe the bloodvessels in it. Pull off the membrane (pia mater). Compare the pia mater with the dura mater in structure and position.

The arachnoid membrane is not found easily. It is between the dura mater and pia mater, consists of two layers of very delicate serous membrane which form a closed sac and secrete the serous liquid found in the sac.

What is the average weight of the brain? Upon what do the size and weight depend? What is the relation of the brain to the mental power?

Reading,—"How to Keep Well," pp. 147, 148. "Our Bodies," pp. 143, 145. Science Primer, Physiology, Foster p. 17.

Remove the dura mater. Find the upper larger part of the brain (cerebrum). What is its form? Observe how it is divided. What is each part called? Observe at the bottom of the longitudinal fissure how the two parts are connected.

What portion in size and weight of the whole brain is the cerebrum?

Observe the ridges of the cerebrum. Describe them. Observe the depth of the depressions. Make sections in different directions through the cerebrum. Of what kinds of matter does it consist? Where is each kind? Draw a diagram of a section.

Reading,—"Our Bodies," pp. 144, 145. Animal Physiology, Fothergill, pp. 83-88. "Human Body, Elem. Course," pp. 194, 195.

Find the lower, back part of the brain (cerebellum). What is its form? Observe how it is divided. What is each part called? Observe how the two parts are connected.

Compare the cerebrum and cerebellum in size and weight.

Observe the ridges of the cerebellum. Describe them. Make vertical sections through the cerebellum. Of what kinds of matter does it consist? Where is each kind? What is the appearance of a section like? Draw a diagram of a section.

Reading,—"Our Bodies," p. 145. Animal Physiology, p. 89.

Find the upper end of the spinal end (medulla oblongata). Trace it through the cerebellum to the cerebrum.

Compare the size of the medulla oblongata and spinal cord.

Observe nerves originating in the medulla. Make longitudinal sections through it. Of what kinds of matter does it consist? Where is each?

Reading,—"Our Bodies," p. 146. Animal Physiology, pp. 89, 90.

Spinal Cord. Specimens,—spinal cord of pig or ox, brain and spinal cord exposed in a frog.

Find if possible in the spinal canal of an ox or pig (while the meat hangs in the market) the dura mater which is continuous with the dura mater of the brain. Observe the spinal nerves extending from the cord.

Find the membrane on the surface of the cord. What is it like? Where is it? Name it.

The arachnoid will not be easily found. Show by a diagram the relative position of the cord and its membranes.

What is the length of the spinal cord? How far below the ribs does it extend? Compare the diameters of different parts.

Make cross sections. How is the spinal cord divided? Of what kinds of matter does the cord consist? Where is each? Draw a diagram of a section.

Reading,—"How to Keep Well," p. 149. "Our Bodies," p. 146. "Human Body, Elem. Course," p. 195.

Cranial Nerves. Find on the base of the brain of a calf or sheep the origin of the cranial nerves. Study diagrams of the base of the brain and of the distribution of cranial nerves especially of the trifacial (5th pair), of the facial (7th pair), and of the pneumogastric (10th pair).

Reading,—"Our Bodies," p. 146. Science Primer, Physiology, Foster, p. 18. Animal Physiology, pp. 90, 91. "Human Body, Elem. Course," pp. 195, 196. A. P. H., Calvin Cutter, pp. 221, 222. A. P. H., Walker, pp. 241-243.

Spinal Nerves. Find on spinal cord from the ox or pig the origin of the spinal nerves. Study diagrams of the spinal cord, of the origin of the spinal nerves and of their distribution and termination.

Reading,—"How to Keep Well," p. 149. "Our Bodies," p. 150. Science Primer, Physiology, Foster, pp. 18, 19. "Human Body, Elem. Course," pp. 195, 196.

Sympathetic System. Find the ganglia in a frog. Study diagrams of the ganglia and of the nerves originating in them.

Reading,—"Our Bodies," p. 152. "Human Body, Elem. Course," pp. 200, 201.

The Functions of the Organs.

Nerve Centers and Nerve Fibres.

Reading,—"How to Keep Well," pp. 149-153. "Our Bodies," pp. 148-150. "Human Body and Its Health," pp. 147-150. "Animal Physiology, "Fothergill, pp. 75-81. "Human Body, Elem. Course," pp. 196-199. ("Human Body, Briefer Course," pp. 304-311.)

Cerebrum. Reading,—"Human Body and Its Health," p. 150. Animal Physiology, pp. 92-95. "Human Body, Elem. Course," pp. 201, 202. "Essentials of A. P. H.," p. 197.

Cerebellum. Reading,—"Essentials of A. P. H.," pp. 202, 203. "Human Body, Briefer Course," pp, 306, 307.

Medulla Oblongata. Reading.—"Essentials of A. P. H.," pp. 205, 217. "Human Body, Briefer Course," pp. 307-309.

Spinal Cord. Animal Physiology, pp. 96-100. ("Essentials of A. P. H.," pp. 184-193. "Human Body, Briefer Course," pp. 301-304.)

Sympathetic System. Reading,—"Essentials of A. P. H.," pp. 174-182. A. P. H., Calvin Cutter, pp. 231-233.

The Care of the Organs.

The harmonious development of the nervous system depends on the proper activity of all its powers.

The length of time and degree of intensity of the work should depend on the age, temperament, and health of the individual.

The kind and amount of rest should depend on the kind, length of time, and degree of intensity of the work done. The kind and amount of rest should also be adapted to the age and health of the person.

Sleep is the best form of rest from mental effort. The time and amount of sleep should be adapted to the special needs of each individual.

The health of the nervous system depends largely on the health of the organs of the chest and abdomen.

Sunlight and pure air are very necessary to the well-being of the nervous system.

Reading,—"How to Keep Well," pp. 153-158. "Our Bodies," pp. 152-156. "Human Body and Its Health," p. 151. "Human Body, Elem. Course," pp. 203-212. "Essentials of A. P. H.," pp. 208-216.

Alcohol. Cite known cases. Read newspapers.

Reading,—"How to Keep Well," pp. 157-160. "Our Bodies," pp. 157-160. "Human Body and Its Health," pp. 151-153. "Human Body, Elem. Course," pp. 212-215.

Tobacco, Opium, etc. Reading,—"How to Keep Well," pp. 160-165. "Our Bodies," pp. 160-167. "Human Body, Elem. Course," pp. 216-222.

THE SPECIAL SENSES.

The Sense of Touch.

Review pp. 2, 3. "Our Bodies," pp. 169, 170.

Organ. Teach by experiment. The true skin and mucous membrane of the mouth are the organs of touch.

Nerve. The nerves of touch are the sensory nerves in the true skin and the mucous membrane of the mouth.

Function. Teach by experiments. By means of these nerves we recognize pressure exerted on the skin, the degree of force exerted, and the point of contact.

Care of the organ. Training is necessary that one may be able to recognize slight impressions. Calluses, some injuries, uncleanness dull the impression.

Knowledge gained. Teach by experiments. Through the sense of touch one knows the existence of external objects, the degrees of resistance to muscular effort, and the qualities implied in this knowledge.

Reading,—"How to Keep Well," p. 168. "Our Bodies," p. 171. "Human Body, Elem. Course," pp. 236, 237.

The Sense of Sight.

Organ. Specimens,—*a*, eyes in the human body, eyes of an ox; *b*, muscle and fat removed from one, and *c* not removed from the other; *d*, skull of an animal.

Review carefully previous teaching (pp. 3, 4) and then have pupils observe as follows:

Muscles of the eye. Find on *c* the position and attachment of the muscles of the eye.

Optic nerve. Find the nerve. Observe where the nerve enters the eye. Cut the nerve longitudinally. Of what is the nerve made? With what is it covered?

Coats. Hold *b* in the palm of the hand, cornea downward. Snip with sharp pointed scissors a small hole through the side of the eye. Introduce one point of the scissors and keeping the inside point next the coats cut around the eye parallel with the cornea. Raise carefully the back part. If the cut is successful the coats of the eye will be undisturbed. If the eye has been hardened in alcohol or other liquid explanation of appearance of otherwise transparent parts must be made.

Observe on the back part of the eye the inside coat (retina), its point of entrance, the distribution of fibres, fine branching bloodvessels on this coat. Observe the color and thickness of the middle coat (choroid). Observe the color and thickness of the outside coat (sclerotic). Observe the jelly-like substance (vitreous humor) resting on the front part of the eye, what encloses it, and what covers it. Observe the body (crystalline lens) in front of the vitreous humor, its form, color, size, and against what it was placed. Remove the portion of the retina on the front part of the eye, and observe how far forward the retina extends. Find a ring of lines (ciliary processes) extending from the iris. Raise the iris and ciliary processes and find of which coat they are parts. Find the cornea and of what it is a part. (The teacher should make necessary explanations concerning the aqueous humor.) Study a diagram of an eye. Draw one.

Functions. External coat gives form and protection. Of the middle coat the choroid absorbs light, the ciliary processes help to regulate the shape of the lens, the iris regulates the amount of light admitted. The internal coat is the nerve of sight. The aqueous and vitreous humors give form to the eye. The crystalline lens brings rays to a focus.

Lachrymal Apparatus. Observe fully the course of the tears. Infer whence they came, the position of the organ secreting them and of the ducts. Then study a diagram of the gland and its ducts. Find near the inner corner of each eye on each eyelid a slight elevation. Find the minute hole on each elevation. Study a diagram of the canals of which these openings are the beginnings, and of the nasal duct into which the canals empty. What is the use of the tears? What causes variations in the flow of the tears?

Eyelids, eyelashes, eyebrows. Find the uses of each.

Reading.—"How to Keep Well," pp. 175-179. "Our Bodies," pp. 180-187. "Human Body and Its Health," pp. 170-173. "Human Body, Elem. Course," pp. 225-229.

The Care of the Organs. Review p. 4.

Light. The light should be clear, steady, reflected, from the side and above, not too bright.

Position. The line of vision should be nearly at right angles to the work. In reading and writing the head and trunk should be kept as erect as possible.

Distance. The work should be at the greatest distance at which distinct vision is easy. How can the eyes be rested? Why is frequent rest necessary?

Defective vision. Nearsightedness, farsightedness, color blindness. What is each? How is each caused? How can each be helped? (Test your pupils on each point.)

In case of accidents. Teach your pupils how to remove a cinder from the eye, how to bandage an eye.

Condition of activity. See experiments, p. 3.

Knowledge gained. Primarily, colors are known through sight. Secondly, other qualities first known through touch may be gained.

Reading.—"How to Keep Well," pp. 179, 180. "Our Bodies," pp. 187-190. "Human Body and Its Health," pp. 173-176. "Human Body, Elem. Course," pp. 229-232.

The Sense of Hearing.

Review pp. 4, 5. Topics as for Sense of Sight.

Reading.—"How to Keep Well," pp. 172-174. "Our Bodies," pp. 174-179. "Human Body and Its Health," pp. 167-169. "Animal Physiology," pp. 107-109. "Human Body, Elem. Course," pp. 232-236.

The Sense of Taste.

Review pp. 5, 6. Topics as for Sense of Sight.

Reading.—"How to Keep Well," p. 169. "Our Bodies," pp. 171-172. "Animal Physiology," pp. 109-110.

The Sense of Smell.

Review, pp. 6, 7. Topics as for Sense of Sight.

Reading.—"How to Keep Well," p. 172. "Our Bodies," pp. 172 174. "Animal Physiology," pp. 111 112. "Human Body, Elem. Course," p. 238.

Effects of Alcohol on the Senses.

THE SKIN.

Structure of the Skin.

Scarf Skin. (*Epidermis or Cuticle.*) Observe the part of skin which is raised by a blister. Observe the callous skin on the palm of the hand or bottom of the foot. Prick it slightly with a needle. Prick slightly the back of the hand, the cheek. Where is the outer skin the thickest?

True Skin. (*Dermis or Cutis vera.*) Prick the skin under a blister. See diagrams A. P. H., Walker, p. 42. "Human Body, Elem. Course," p. 61.

Pigment Cells, Papillae, Furrows.

Perspiratory glands. Review p. 56.

Oil glands.

Bloodvessels, Nerves.

Hair, Nails.

Reading,—"How to Keep Well," pp. 129-131, 134-136. "Our Bodies," pp. 125-132. "Human Body and Its Health," pp. 156-160. "Essentials of A. P. H.," pp. 217-222.

Functions of the Skin.

By observation and reading the following conclusions should be reached:

Protective covering.

Organ of absorption—fluids.

Organ of respiration—takes in oxygen, gives off carbonic gas.

Organ of secretion—oil.

Organ of excretion—perspiration.

Organ of sensation—nerves.

Regulator of animal heat.

Beautifies the body.

Reading,—"How to Keep Well," pp. 131, 132, 138-141. "Science Primer, Physiology," pp. 103-109. "Human Body and Its Health," pp. 161 165. "Human Body, Elem. Course," pp. 59-70. "Essentials of A. P. H.," pp. 223-230. A. P. H., Walker, pp. 42-52.

Care of the Skin.

Bathing. Necessity of. Methods: their relative value; adaption to time.

Reading,—"How to Keep Well," pp. 133, 136, 137. "Our Bodies," pp. 133-135. "Human Body and Its Health," pp. 165-167. "Human Body, Elem. Course, pp. 71-75. "Essentials of A. P. H.," pp. 231-235. A. P. H., Walker, pp. 52-61.

Clothing. Review pp. 25, 26.

Reading,—"How to Keep Well," pp. 141-143. "Our Bodies," pp. pp. 136-138. "Human Body, Elem. Course," pp. 76, 80. "Essentials of A. P. H., pp. 235-236. A. P. H., Walker, pp. 62-73.

Injuries. Blister, burn, scald, cut, bruise, corns, bunion, ingrowing nails, frostbites, chillblains. How are corns, bunions, etc., caused? How should each of these injuries be treated?

Effects of Alcohol.

Reading,—"How to Keep Well," pp. 143, 144.

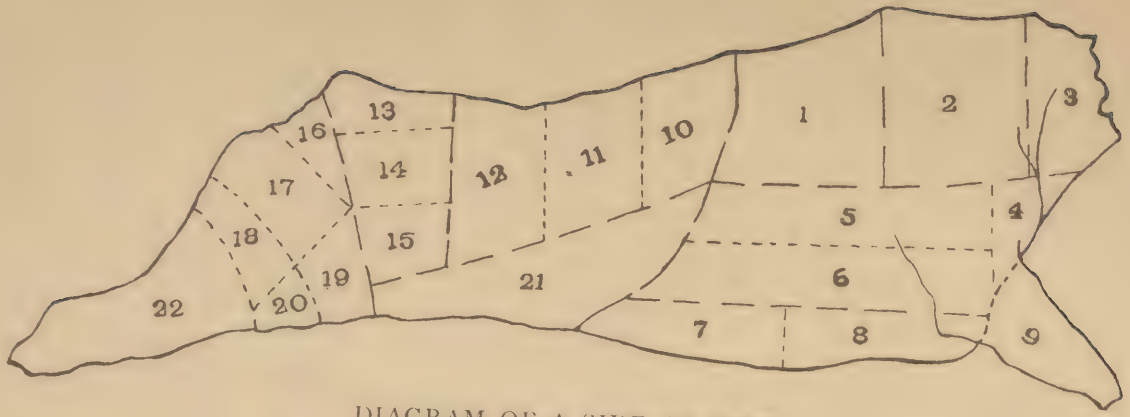


DIAGRAM OF A SIDE OF BEEF.

1—9. Fore quarter.
10—22. Hind quarter.

1. Prime ribs
2. Chuck ribs } back half.
3. Neck piece
4. Sticking piece
5. Plate piece } rattle rand.
6. Middle cut
7. Navel end
8. Thick end } brisket.
9. Shin.

10. Tip of
11. Second cut } sirloin.
12. First cut
13. Back of
14. Middle of } rump.
15. Face of
16. Aitch piece.
17. Best part of round.
18. Poorer part of round.
19. Best part of vein.
20. Poorer part of vein.
21. Flank.
22. Shank.

Distribution of bones and joints among cuts of beef.

There are several methods of cutting beef for the retail trade. One of the common methods distributes the bones and joints as follows:

The scapula (shoulder blade) except the socket, portions of 5 or 6 ribs, and the adjoining parts of the vertebrae are in the chuck piece.

The humerus (arm bone) except the enlargement at the elbow is in the rattle rand behind the sticking piece and is removed when this piece is cut off.

The enlarged end of the humerus (arm bone) at the elbow, the radius and ulna (shin bone), and carpus (knee) are in the shin.

The metacarpus (fore cannon bone) and phalanges (pasterns) are cut off in one piece (the foot) when the ox is dressed.

The ribs are not found whole in any of the cuts. The longest pieces are in the sirloin.

The innominatum (hip bone) is in the rump and aitch piece, the larger portion of the bone being in the rump.

The head of the femur (thigh bone) is usually in the rump. The amount of the femur cut off varies from a small section of the ball to a piece several inches long. When much of the femur is cut off the aitch piece usually has a section of the ball. The middle part of the femur is in the round.

The lower end of the femur, the patella (whirl bone), the tibia (shank bone), and the tarsus (hock) are in the shank. Sometimes the portion of the femur which is found usually in the round is not cut from the part in the shank.

The metatarsus (hind cannon bone) and phalanges (pasterns) are cut off in one piece (the foot) when the ox is dressed.

The elbow and carpal (knee) joints are in the shin. The knee (stifle) and tarsal (hock or gambrel) joints are in the shank.

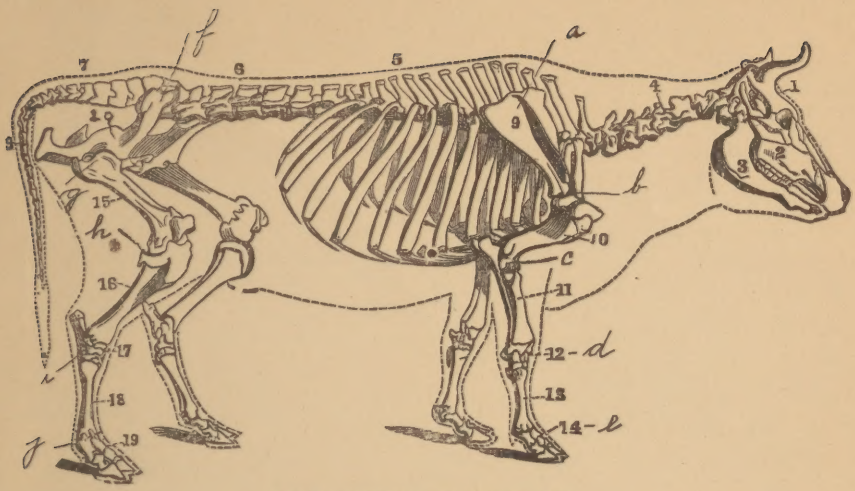
Distribution of bones and joints among cuts of mutton, lamb, or veal.

The scapula, humerus, radius and ulna are in a shoulder of mutton.

Six ribs with adjoining parts of the vertebrae and sternum are in a breast of mutton.

Seven lower ribs and adjoining vertebrae are in the loin.

The innominatum, adjoining vertebrae, femur, patella, tibia are in the leg of mutton.



SKELETON OF AN OX.

		Names of the corresponding bones of the human body	*and ox (sheep).*
1.	Frontal bone of the head,	forehead,	
2.	Superior maxillary,	upper jaw,	upper jaw.
3.	Inferior maxillary,	lower jaw,	upper jaw.
4.	Cervical vertebrae,	in the neck,	in the neck.
5.	Dorsal vetrebrae,	in the chest,	in the chest.
6.	Lumbar vertebrae,	in the loins,	in the loins.
7.	Sacral vertebrae,	in the pelvis,	in the rump.
8.	Caudal vertebrae,	coccyx,	in the tail.
	Ribs,	in the chest,	in the chest.
	Sternum,	breast bone,	brisket bone.
9.	Scapula,	shoulder blade,	shoulder blade.
10.	Humerus,	in upper arm,	arm bone.
11.	Radius and Ulna,	in fore arm,	shin bone.
12.	Carpus,	in the wrist,	knee.
13.	Metacarpus,	in the palm,	fore cannon bone.
14.	Phalanges,	in the fingers,	pasterns.
20.	Innominatum,	hip bone,	aitch or edge bone.
15.	Femur,	thigh bone,	thigh bone.
	Patella,	knee pan,	stifle or whirl-bone.
16.	Tibia,	shin bone,	shank bone.
17.	Tarsus,	in the ankle,	hock.
18.	Metatarsus,	in the instep,	hind cannon bone.
19.	Phalanges,	in the toes,	pasterns.

		Names of the corresponding joints of the human body	*and ox (sheep).*
a.	No joint in either. Attachment by muscle and tendon.		
b.	Shoulder,	ball and socket,	shoulder.
c.	Elbow,	hinge,	elbow.
d.	Wrist,	gliding,	knee.
e.	Finger,	hinge,	pastern.
f.	Union of hip bone and backbone.		
g.	Hip,	ball and socket,	hip.
h.	Knee,	hinge,	stifle.
i.	Ankle,	gliding,	hock or gambrel.
j.	Toe,	hinge,	pastern.